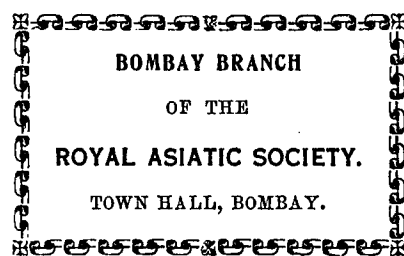


Agriculture Dept.
Punjab
Report on the operations
1914-15 to 1918-19



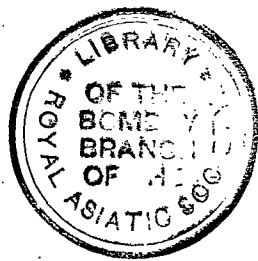
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REPORT ON THE OPERATIONS OF THE
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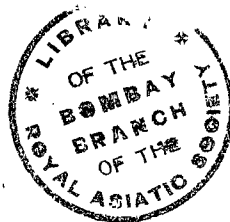
DEPARTMENT OF AGRICULTURE, PUNJAB,

FOR THE YEAR ENDING 30TH JUNE 1915.

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Lahore:

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*Proceedings of His Honour the Lieutenant-Governor of the Punjab in the
Department of Revenue and Agriculture—Agriculture, No. 231, dated
the 17th of November 1915.*

READ—

Letter No. 773, dated 21st October 1915, from the Senior Secretary to the Financial Commissioner Punjab, forwarding, with the comments of the Financial Commissioner, the Annual Report of the Operations of the Department of Agriculture in the Punjab, for the year ending 30th June 1915.

REMARKS.—During the year under report the scale of pay of the Agricultural and Research Assistants was considerably improved. The superior staff of the Department was also strengthened by the appointment of an Agricultural Engineer; his work is at present almost entirely confined to the superintendence and direction of well-boring operations, but the field for his energies is by no means to be confined to such operations, and valuable results in other directions may be expected with more experience of the problems to be solved.

2. The change of syllabus at the Agricultural College and the improvement of the prospects of the students have had the desired effect, and it is most satisfactory to find so large an increase in the number of applicants for admission to the College. The interest taken by District Boards in the College is also gratifying, and over 40 scholarships have been offered for sons of zamindars attending the short vernacular course which is proving most successful. In several cases District Boards are sending their own men for training at the College preparatory to their appointment as Arboricultural Daroghas. It is thus satisfactory to find that the College is providing not only for students seeking subsequent employment in the Department but also for others who will apply the knowledge gained to their own affairs. The training class for Assistant Commissioners, Canal Officers, and Extra Assistant Commissioners also affords young officers a most valuable introduction to Indian rural economy.

3. The results of experimental cultivation at the various stations were to a great extent vitiated by the abnormal character of the seasons. Unusually late autumn rains, hail, and early frosts damaged the autumn crops and especially cotton and cane, while wheat and gram were injuriously affected in their early stages by prolonged winter frosts. Heavy rains also fell late in the spring accompanied by high winds and these were followed by a spell of unusual heat in April and May, and the rabi crop which had been of exceptional promise was thus still further injured. Confirmation of the view that it is uneconomical to employ artificial manures in the Punjab was, however, obtained, and the superiority of Punjab 11 wheat was again demonstrated. Satisfactory results were again attained from the acclimatized American cotton 4—F, and the rapid spread of this variety in the Chenab Colony is a very hopeful feature. Work on the new farm at Hansi has been well begun, and Government has sanctioned the construction of the various buildings required. The researches of the Agricultural Chemist and Mr. Grove with regard to the insect pests which infest stored grain have yielded valuable results,—results, however, which, as the Financial Commissioner remarks, are negative in that they tend to prove that the only effective means of dealing with these pests is by the expensive method of mechanical separation. The experiments conducted at Narwala for the reclamation of alkali land have proved successful: the methods adopted were deep cultivation combined with surface flooding and lateral drainage, and a very fine yield of wheat was obtained from land so treated. The final report of the Agricultural Chemist on this experiment is awaited with interest, as the process can be extended to large areas of uncultivated *kallarathi* land if shown to have been economically sound. The survey of Gurdaspur sugarcane has now been completed; the investigations appear to show that in the north of the province where the crop is subject to

attacks of frost, the growth of a high class cane giving good yields cannot be expected. The work of the Economic Botanist in the selection of acclimatised American cottons is a most promising feature of the Department's activities. The results achieved already are valuable, and the prices realised for cotton grown from seed distributed by the Department prove the value of the service rendered to the Punjab cultivator by the introduction of these acclimatized American varieties, while the vastly increased exports of Indian grown cotton in the last 2 or 3 years show the degree of success which has already been obtained in producing a cotton suitable for European mills.

4. There was a considerable and most satisfactory rise in the number of western agricultural implements sold. The Director's remarks on the increasing popularity of these instruments and of the selected seed which is distributed by the Department are of particular interest, and bear out the truth of the remark made last year by Mr. Maynard that the "best demonstrator is the cultivator who has himself used an implement and found it profitable." With regard to the utilization of selected seed His Honour heartily approves the suggestion of the Financial Commissioner that use should be made of estates under the Court of Wards, and hopes that the Court will invite the attention of the managers of all such estates to the advantages to be gained by purchasing selected seed from the Department.

5. The number of wells bored was not so great as in the previous year, and the percentage of successes was only slightly higher, but the report of the Agricultural Engineer shows that the matter is receiving careful consideration, and a great improvement may be expected with the treatment of the subject on proper scientific lines. His Honour entirely concurs with the remarks of the Financial Commissioner with regard to the responsibilities of Tahsildars in the preparation of programmes of work, and trusts that the Director will not again have cause to complain of their indifference. With regard to the minor activities of the Department it is satisfactory to note the progress of sericulture, and the promising start made in apiculture. The cultivation of olives, with which however the Agricultural Department is not at present concerned, is still only in an infant stage, but interesting developments may be expected if the proposals now under the consideration of Government for the lease of certain rakhs in the Jhelum and Attock Districts to a private company for olive cultivation mature.

6. The Lieutenant-Governor is pleased to find that Mr. Townsend recognises the importance of the part which can be played by Co-operative Societies in the promotion of improved methods of agriculture. In times of financial stress like the past year the Societies may not be able to make very extensive purchases of seed or implements, and in this respect, from a commercial point of view, may not be satisfactory customers to deal with, but from the educative point of view, which should be the chief point of view of the Agricultural Department, the Societies constitute a most valuable medium through which the teachings of the Department may reach the cultivators whom it is intended to benefit. In normal years too it is to these Societies that the Department must look to provide the means to enable the small cultivators in combination to employ improved instruments for the purchase of which their individual resources are insufficient. At the same time the various Agricultural Associations are undoubtedly a most useful means of disseminating knowledge and fostering the adoption of improved methods of agriculture: they afford opportunities for exchange of opinions among zamindars from all parts of a district, and should thus enable the experience gained locally by the Co-operative Societies operating in single villages to be of advantage to the rest of the district.

7. His Honour desires to thank Mr. Townsend for an interesting report which affords many cheering indications that the work of the Department is becoming better understood and more widely appreciated by the practical agriculturists of the Province. In this connection he would again urge the advantages of interesting not only prominent agriculturists but officials of

Departments like the Revenue and Irrigation Departments which work chiefly among the agricultural population, in the methods pursued and the results achieved in the Lyallpur College. He knows that Mr. Barnes and his staff are always ready and willing to assist in this matter. The Lieutenant-Governor cordially agrees with the Financial Commissioner that Mr. Townsend has made a good start in his new office and congratulates him and the staff of the Department on the success which has attended their operations in the past year.

ORDER.—Ordered that a copy of the foregoing remarks be forwarded to the Senior Secretary to the Financial Commissioners, Punjab, for the information of the Financial Commissioners; that they be published in the *Punjab Gazette*, and submitted with copies of the Report to the Government of India in the Department of Revenue and Agriculture.

By order of His Honour the Lieutenant-Governor, Punjab,

J. P. THOMPSON,

Revenue Secretary to Government, Punjab.

No. 773

FINANCIAL COMMISSIONERS' OFFICE :

Dated Lahore, 21st October 1915.

FROM

MILES IRVING, ESQUIRE, I.C.S.,

Senior Secretary to the Financial Commissioners, Punjab,

TO

THE HON'BLE MR. J. P. THOMPSON, I.C.S.,

Revenue Secretary to Government, Punjab.

SIR,

I AM directed to submit the report of the operations of the Agricultural Department for the year 1914-15 with the following remarks of the Financial Commissioner.

2. A most satisfactory feature of the year's report is the turn which has been taken, it is to be hoped permanently, in the fortunes of the Agricultural College. Whereas in 1913 no students whatever were forthcoming, in October 1914 the Principal was able to form a class of 22 out of 58 applicants. This development is rightly attributed in the first place to the increase in the pay of Agricultural and Research Assistants, and in the second to shortening and making less expensive the course leading to the diploma examination. There is no disguising the fact that it is the prospect of obtaining Government employment that is the chief, if not the sole, incentive to undergoing a prolonged course of Agricultural study: and for the present at least it is only by accepting this position and making provision accordingly that the classes of the Agricultural College can be filled. The Financial Commissioner therefore welcomes the action of the Chief Engineer in making the diploma of the College a recommendation for the post of Zilladar. At the same time it is gratifying to find signs that a short practical course will be attended by agriculturists who have only the improvement of their own efficiency in view. Sixteen sons of *zamindars* attended a six months' course conducted in the Vernacular, and more, it is expected, will attend next year. The Financial Commissioner acknowledges with pleasure the liberality of Sheikh Riaz Hussain and other private donors who have offered scholarships for attendance at this class.

3. The appendices dealing with Chemical Research, Botany and Entomology are full of interesting matter. The investigations into the natural history of the wheat weevil and other insect pests which infest stored grain have given important negative results; it appears that these pests cannot be destroyed by drying while the use against them of asphyxiating gases involves injury to the grain. The only apparent method that remains, that of mechanical separation, will not be easy to carry out except in large granaries and elevators. The scourge of alkali in land is being dealt with experimentally at Narwala by means of lateral drainage and deep cultivation. That these methods are successful in completely reclaiming alkali lands has been fully demonstrated. Their economic possibilities have still to be worked out. The problem of reducing the initial cost of reclamation operations has to be surmounted, and information is required as to the recurring expenditure, if any, necessary to prevent the land from reverting to its original condition.

It has been ascertained that the bones which are commonly exported from the Punjab in large quantities are purchased entirely for the glue and gelatine trades. Mr. Barnes' suggestion that Government should assist in developing the business of manufacturing crude glue locally has much to commend it: not only would the much needed phosphates be kept in the country but a new and doubtless profitable industry would be established. The matter is one which might be investigated by the Director of Industries.

4. In the domain of the Economic Botanist some interesting results have been achieved in the selection of acclimatised American cottons. The Punjab can grow cotton as good or better than middling Americans, and suited to the Lancashire mills. The proposal to lease to a British syndicate a large area on the Lower Bari Doab for the purpose of growing such cotton is at present in abeyance owing to the war. In the meantime it is a matter for congratulation that the campaign against the boll-worm is now a matter of yearly routine, carried on, it appears, with effective results. It is to be hoped that the enquiry into the other insect pests of cotton such as grass-hoppers and cotton bugs will result in the discovery of methods of control as effective as dissemination of the parasite seems to be in the case of the boll-worm.

5. Two hundred and thirty-seven bores were sunk in 11 districts, some 60 per cent. being successful. The appointment of an Agricultural Engineer will, it is hoped, result in a higher percentage of success being obtained by the variation of the method of treatment to suit the conditions of the sub-soil. Meanwhile the demand for the services of the well-boring staff is increasing. The Financial Commissioner notes with some concern the remark of the Director that owing to the apathy of Tahsildars programmes of work are not properly prepared. Tahsildars are a hard-worked body of men, but if they are in touch with their jurisdictions as they should be, the preparation of these programmes should not be a difficult matter. In any case this duty is one which must not be suffered to be neglected and Collectors and Revenue Assistants should see that it is properly performed.

6. The Financial Commissioner has read with interest Mr. Townsend's remarks on the progress of sericulture which appears to be establishing itself as a paying cottage industry. He has just received and will shortly submit to Government Commissioner Booth Tucker's proposals for a Central Sericulture School at Simla. He observes that the distribution of seed has been limited by the insufficiency of mulberry trees. This is a matter which should receive attention in the District programmes of arboriculture.

7. District work, which Mr. Townsend rightly describes as the most important of the activities of his Department, shows satisfactory progress, and the fact that the benefits of the Rajah plough, Pusa wheat and the chain harrow should have passed into a proverb is a significant indication of the trend of feeling among the peasants. The Financial Commissioner is disposed to agree with Mr. Townsend who thinks that it is desirable to use the existing Co-operative Credit Societies for agricultural purposes, such as the sale of implements and distribution of seed, rather than with Mr. Hamilton, who was disposed to have entirely separate Agricultural societies. The Director speaks of some embarrassment caused by the failure of societies to purchase as much selected seed as had been expected; if any difficulty is experienced in disposing of as much seed as is hoped, use might be made of estates under the Court of Wards. This appears to be done in the cases of the Mamdot and Guru Harsahai estates; but there are estates all over the Province who could purchase seed with benefit both to themselves and the Department.

8. The interest and activity of which Mr. Townsend has already given evidence in his control of the Department promise well for its future development under his guidance and justify his selection as Director by Government.

I have, &c.,

MILES IRVING,

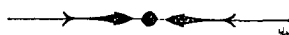
Senior Secretary to the Financial Commissioners, Punjab.

ANNUAL REPORT

OF THE

DEPARTMENT OF AGRICULTURE, PUNJAB,

FOR THE YEAR ENDING 30TH JUNE 1915.



1. Mr. Hamilton was Director of Agriculture till November 26th, 1914, when I took charge. Mr. O. T. Faulkner assumed charge of his duties as third Deputy Director of Agriculture in October. Since then he has been under training at Lyallpur under the Professor of Agriculture, to whom he has been giving some assistance in lecturing. He has also been assisting the Principal in the management of the college office, whereby he has also doubtless rendered himself more potentially useful to Government. It is hoped that financial conditions will soon allow the establishment of his farm in the north Punjab. Mr. Miller Brownlie, late Municipal Engineer, Amritsar, assumed charge of his duties as 'Agricultural Engineer in the middle of February. Sardar Darshan Singh, Deputy Director of Agriculture, took charge of the Hansi farm on October 10th.

Mr. Southern, Deputy Director of Agriculture, has gone to the Indian Army Reserve of officers: his duties are being carried on by M. Fatteh-uddin, Assistant Director of Agriculture. Mr. Milne, Economic Botanist, was on leave till December 15th, 1914: his duties were carried on by Lala Jai Chand, Assistant Professor of Botany. M. Charan Singh, who was recently appointed Assistant Director of Agriculture, has been placed in charge of the Chunian and Lower Bari Doab colonies, with head-quarters at Montgomery: the latter colony, as just developing, should offer him a wide sphere of work, more particularly in introducing good types of wheat and cotton, in pushing improved implements, and in assisting with his advice the various concessionaires, as Mr. Conville, Captain Vanrenen, Sardar Jogindra Singh, and others, to whom Government is leasing land for various purposes. Mr. Grove, Supernumerary Entomologist worked at Lyallpur till the end of April, studying, in co-operation with the Agricultural Chemist, various weevils which damage wheat in this province. The results of their work will, it is hoped, soon be published as a Pusa memoir.

2. In his speech at the Agricultural College on March 17th, His Honour made a very welcome announcement of much needed improvements in the scale of pay of Agricultural and Research Assistants. From April 1st their pay has been fixed as follows:—

	Rs.
Three on	250
Five „	200
Seven „	160
Nine „	120
Six „	80
Five „	60

The scale of pay has already had an excellent effect on the present staff, who are working hard. It has also undoubtedly been the principal contributory cause of the increased popularity of the Agricultural College, with which I deal in the next paragraph.

3. I will not repeat here what is said in full detail in the Principal's report (appendix I). There was a class of 23 first-year students at the college in October 1914: at the corresponding date of 1913 the same class was empty! So there was no second-year class during the year under report. Fourteen third-year candidates passed the diploma examination in May 1915: I have given posts in the department to six of these. Another contributory cause of the increased popularity of the college is the fact that Mr. Ward, Chief Engineer, Irrigation, has told the many candidates for the post of zilladar who came to him that in future men with the college diploma will have a better chance of getting appointments as such than those without it. This is all to the good.

The present first-year class numbered 32 this August, and it is hoped to soon make it up to the full number of 38: but mention of this will be made more appropriately in next year's report.

The Principal's report describes in detail the great change that is now being given effect to at the college, where the course is now divided into two parts of two years each, instead of one course lasting for three years.

The attendance at the vernacular class, which lasts for six months in the winter, numbered sixteen, all the students being sons of zemindars. This I consider a most hopeful branch of work. Many districts have followed the good example of Sheikh Riaz Hussain of Multan, and are offering scholarships to be held at this class. As a result it is hoped to have a considerably larger class this winter.

4. Full details are given in appendix II. As already said, the joint work of Messrs. Grove and Barnes on wheat weevils will, it is hoped, soon be published. It should be of much use in connection with the wheat elevators, which will doubtless cover the colony areas at some future time. The Narwala experiment on the reclamation of kallar land, though not yet completed, is very promising: the wheat grown last winter on the land treated exceeded considerably in outturn the average crop for the colony as a whole. It is hoped eventually to be able to undertake the reclamation of such lands in any part of the province at a fixed sum per acre. I do not think this province, with its cold winter, will ever be able to produce as good sugarcane as the more southern parts of India. As regards Mr. Barnes' remarks regarding phosphatic manures, our experiments with these on our farms have not yet given us conclusive results—principally because of the unfavourable seasons: see appendices VI and VII.

5. See appendix III. I agree with my predecessor's opinion that the work done is more agricultural than botanical.

The date-palms are doing very well in the south-east of the province, particularly Muzaffargarh, though the rains last year did considerable damage. The war prevented the assistant who went to Basra to fetch more suckers from procuring any.

6. Work has been proceeding as usual: see appendix IV. The cotton bollworm gave no trouble this year: care is always taken to breed the parasite as soon as possible in case bollworm should appear. The treatment of moth borer in young sugarcane by cutting the "dead heart" of the plant out is successful, and is increasing in popularity in the districts in which we are working.

Mention of the work done for us by Mr. Grove has already been made.

7. Appendix IV shows that the department distributed 165 ounces of French seed this year, against 136 ounces issued last year. Kamins in the submontane districts, as Ambala, Hoshiarpur, Gurdaspur and Sialkot, are

certainly beginning to see there is money in this : and at the cocoon exhibition, held at Gurdaspur in May, a Sikh zaildar carried off one of the prizes, and admitted as he did so that he made a good deal of money out of his silk-worms. I do not however anticipate that the ordinary Punjab zemindar, as opposed to the *Kamin*, will ever take to sericulture on a large scale : to put it briefly, he is too well off to make the 30 or 40 rupees he can get from an expenditure of Rs. 3 on an ounce of seed compensate for the personal attention to the feeding of the worm that is necessary.

One hopeful method of encouraging silk-worm breeding that has been adopted with success is to have it taught in schools, rewards being given to those boys and masters that show the best results. Last March I found the Brahmin land-owners of the small village of Mirthal in the Pathankot tahsil all taking to sericulture as a result of the money they saw their sons earned from the silk-worms they kept in the school.

In addition to the silk-worm seed which we supervised during the whole process of rearing, we imported 374 ounces of seed from France for Sheikh Ghulam Sadiq of Amritsar for distribution among his Gurdaspur rearers. The Salvation Army reared silk in the year under report in Changa-Manga, Ludhiana and Lahore, and have established small filatures at Ludhiana, Danepore (Lahore) and Chawa Pail (Ludhiana). Commissioner Booth Tucker has now put forward a proposal for a central sericulture school to be located at Simla, which I hope shortly to place before Government.

8. Mr. Cousins, a retired military departmental officer, lately employed at Sanawar, is in receipt of an allowance from Government as practical expert in bee-keeping. His activities are at present confined to the extension of bee-keeping in the hills, though he is anxious to work in the plains also : he successfully transferred a colony of *apis indica* to a Salvation Army settlement at Najibabad, United Provinces, where it is doing well, and he is anxious to do the same in the Punjab. I am deferring my decision till I have an opportunity of going into the matter with him at Sanawar.

The year was not a good one for bees owing to the abnormally mild winter, which excited activity in the bees, and consequent consumption of stores, which could not be replaced even though feeding was resorted to. Mr. Cousins disposed of four colonies of bees in the hills. He also gave—both at Sanawar and neighbouring villages—several lectures with practical demonstrations, which were attended by upper classes of school children, both European and Indian, and villagers. Many individuals came to him for assistance, though not all were from the Punjab : and some 120 letters asking for advice were received and answered by him. As a result of his lectures nine villagers adopted frame hives Mr. Cousins made for them, realizing that they are far superior to the old-fashioned “hole in the wall.” He hopes shortly to introduce to the Punjab hill man the improved wall hive which is advocated by Pusa.

The Salvation Army settlement at Ani, beyond Simla, has made a very promising start in bee-keeping, due doubtless in some measure to advice given by Mr. Cousins to the officer in charge of it, who paid him a personal visit.

The Simla bee-keepers' association has been revived, and Mr. Cousins' advice is available to all its members. For this purpose he pays periodical visits to Simla.

The proposal to import a swarm of bees from England had to be dropped owing to the prevalence of disease among English bees. It may, however, be found possible to import Italian bees. The matter is under consideration.

9. Mr. Brownlie, the Agricultural Engineer, took charge of his duties last February. He worked, therefore, in the department for only a small portion of the year under report.

Agricultural engineering.

The work is practically all confined to well boring, though some larger schemes are under consideration. Full details are given in appendix V. I am confident that Mr. Brownlie will be able to increase the number of successful borings by altering the treatment to meet various sub-soil conditions: at present all conditions are treated in practically the same way. The delay in delivering plant pipes, etc., from England is regrettable, but unavoidable.

Mr. Brownlie is anxious to increase our charges for successful borings: at present we charge only for the pipe left in the well; the footage allowance goes to the borer. He wishes to charge also for a proportion of the pay of the men employed, of establishment charges, of depreciation, etc. Till, however, our well boring operations get more firmly established, I am averse to any increase of the charges.

Much of the time of our borers is wasted owing (a) to the lack of interest tahsildars take in the work. They are supposed to prepare a programme of work for the borer ahead. More than one case has occurred in which a tahsildar, to save himself trouble, has reported that the borer's services were not required in his tahsil, and the borer has subsequently been employed, with advantage, for over a year, in the same tahsil: and (b) to the difficulty of finding labour at harvest time, as the owner of the well which is being improved has to provide the necessary labour for the boring. Steps to lessen these delays are under consideration.

The larger schemes of irrigation mentioned by Mr. Brownlie are promising. I am going into that he mentions in the Gurdaspur district as soon as I return to the plains. I fear, however, the present financial stringency will prevent any large allotments of funds for such purposes in the immediate future.

The larger zemindars of the province are beginning to avail themselves of Mr. Brownlie's services. As his report shows, between February and June, he received 22 applications regarding installations of tube wells for agricultural purposes from private persons. Full particulars were given to all these applicants. It is hoped some of them will result in plants being put down. One such has been ordered from England.

10. (1) *Wheat*.—The year was a bad one for wheat on our Lyallpur and Gurdaspur farms, owing to the heavy rain and wind of the winter which reduced the outturn and shrivelled the grain. So there is not much new to report. Full details will be found in appendices VI and VII. Punjab 11 generally did best at Lyallpur farm, though it was closely followed by Pusa 12. In this connection what is said at the top of page xxvii of appendix VI is specially interesting. As a result of these experiments, Punjab 11 is being pushed in the Chenab colony.

Rain and wind did even more damage at Gurdaspur than Lyallpur. Pusa 4 and Pusa 12 did best: and the Deputy Director of Agriculture thinks one of these will be the most suitable for his circle, which is of course mainly unirrigated. There are, however, powerful reasons which militate against their adoption to the exclusion of all other wheats. One is that they are too early to be grown mixed with gram, as is the common practice in the province. The second is that they ripen early and all at once, and have to be cut immediately, as the grain sheds in the field as soon as the crop is ripe: but the zemindar cannot arrange to get all his grain cut at one time.

(2) *Cotton*.—Yield was not at Lyallpur as good as in previous years for climatic reasons. The Hansi farm, I should note, will be our principal cotton farm soon. For the present, however, I deal with that farm in a separate paragraph, as it has only just been started. The results obtained there will, in future, be incorporated in this paragraph. A spacing experiment carried out with 4-F American cotton, our standard, and satisfactory, American cotton, shows that in poor land a space of 3 feet between the rows gives the best result. This is the usual distance in practice in the colony. In better land a distance of 4½ feet between rows gives better results.

Experiments with *desi* varieties continue. Selection of the common types grown in the colony is now complete, and it is hoped an early decision will be arrived at as to the best pure variety of those now grown in the colony to be pushed. The cotton experiments by the Professor of Agriculture, I should note, have been considerably hampered for want of sufficient land for experimental purposes. I have sent up proposals to remedy this. They will cost Government very little.

(3) *Manures*.—See the same appendices—VI and VII. The results generally show that no artificial manure can be used economically in the Punjab: though super-phosphate at Gurdaspur shows that it ripens the crop earlier than usual, which is often an advantage. The experiment will be continued. Green manuring did not pay at Gurdaspur: but the land there does not require “humus” which green manuring gives, so much as the sandier soils of the colonies.

(4) *General*.—The principal fact emerging in the sugarcane experiments at Lyallpur is that it is uneconomical to add artificials to farm yard manure for this crop. At Gurdaspur the gradual elimination of the sugarcane varieties is proceeding. No advantage was found in early sowings. The cultivation experiments generally did not give many results owing to the nature of the year. For the other interesting experiments which were carried on at the farms, reference should be made to appendices VI and VII. They do not call in their present stage for comment here.

11. During the year considerable progress was made in laying out the new Hansi farm. This is primarily a cotton farm. Full details are given in appendix VIII. The results so far arrived at do not call for any comment: I may, however, note that American cotton promises to do well here, and that the local cotton did better in the year under report than any of the selected varieties imported from Lyallpur.

12. See paragraph 25 of last year's report. This is used as a wheat and a cotton seed farm for the Jhelum colony, and is in charge of an Agricultural Assistant. Some 25 acres are under cotton, nearly all 4-F American: and 67 acres under wheat, all Punjab 11. Though the year was bad for cotton generally, American cotton did much better than *desi*. The wheat yield was about 30 per cent. higher than that of neighbouring zemindars. It was all, I may note, save 5 acres which were badly lodged, cut with the Raja reaper, no labour whatever being employed.

The colony zemindars are beginning to take interest in the farm, and the cultural improvements we recommend, as the sowing of cotton in lines, inter-culture, harrowing, and the use of improved implements, are constantly brought to the notice.

13. Government has sanctioned various special leases of land in the Lower Bari Doab colony for purposes in which the department is acutely interested. The first is that of 3,000 acres to Mr. Conville for growing selected cotton and wheat seed. In July this year some 55 per cent. of the area (1,800 acres) had been broken up, and 300 acres are under American (4-F) cotton, and about 200 under country cotton this harvest. I saw the American cotton in August, and it looked very well. Mr. Conville hopes to put about 500 acres under wheat next *rabi*: he will sow Punjab 11 type, which has done best in the Chenab colony.

I saw Sardar Jogindra Singh's farm last March. He has an area of 2,000 acres, which he has to cultivate by steam ploughing. Some 500 acres of the farm had then been broken up by the steam plough: 400 acres of this was under wheat last *rabi*. The experiment is promising, and the Sardar and his manager were, when I visited the estate, enthusiastic over its prospects.

Four special grants for cattle-breeding have been recently sanctioned, and are being got under way : and a request for a lease for tobacco cultivation by an expert has been forwarded to Government. Conditions of a lease for dairy farm are also under the consideration of Government.

With regard to what is said in paragraph 9 of last year's report regarding a proposed lease to the International Federation of Cotton Spinners for growing American cotton, the war has thrown considerable difficulties in the carrying-out of the scheme. I am now in correspondence with an English body interested in cotton-growing : but I much fear that the difficulty of raising capital at the present time to carry any scheme through will prove insurmountable.

14. Mr. F. J. Mitchell, who is in charge of the olive cultivation in the Salt Range—the department has nothing to do with it—sends the following note as regards them :—

Olives.

"Since our last report of 22nd August 1914 all extensions of the area have been stopped under order from Government, and expenditure for the future so strictly limited that there seems to be little to be done beyond maintaining the present area.

"The balance of allotment for 1914-15 was utilised in experimentally opening up 8 acres 3 kanals of the ground in Gandala, already planted with olives and almonds, and removing the deep-rooted grasses which appeared to be drawing a good deal that was valuable from the soil. It will be interesting to see the effect of this on the growth of trees in the area so opened up as compared with the growth on the area untouched, the soil in the two being practically similar. The growth of the trees in Gandala has on the whole been satisfactory, though it has perhaps been less rapid as regards grafted trees than at Khairi Murat, where, though the soil is shallower, the moisture seems to be retained in places in the rock below.

"In Khairi the trees are now almost free of any disease or insect pest and look very well. Last year 29 trees bore fruit, which were picked at rather an early stage and pickled. The preserved berries were about the same size as those grown in the Jhelum valley, and exactly similar in size to fruit grown on French trees on similar varieties. Something, however, was wrong with the pickling which we have not been able to trace, and the berries presented a curiously black appearance, as compared with those cured in the Jhelum valley. This may be due to the limey nature of the water coming from the spring at Murat village. We have not had this analysed yet, but think it may be worth while doing.

"A scheme, providing a basis on which the work of carrying further the olive experiments at both Khairi Murat and Gandala, is now under consideration by Local Government. Should this prove sufficiently attractive to gain the financial support required, progress will, we hope, be more rapid, as not only will larger funds be available but we shall have the advantage of consultation with Directors of experience in the work, who will keep us right on the recent methods of pruning and treatment of trees under all conditions."

15. Mr. Hamilton said last year that he did not anticipate any great results from our poultry operations. Our experience this year confirm his view. A few native birds are now kept at all our farms with varying success. I have recently sent three good cocks to Gujarkhan, in the Rawalpindi district : it is a great centre for the export of eggs and fowl to Simla. They will run with ordinary hens, and it is hoped an improvement in the breed will gradually appear.

Poultry.

The following is an extract from a note on the poultry in the Lahore Zoo sent me by the Deputy Commissioner of Lahore :—

* * * * *

"The demand for eggs and young stock has not been so great as in previous years. This is due probably to the number of new private breeders and fanciers in the market offering their surplus birds for sale.

"The cross-breeding experiments have been very successful, the pullets produced being excellent layers and splendid utility birds. The cockerels were equally good, and are admirably fitted to improve the *desi* fowl, many of the latter birds were sold cheaply for the purposes of this improvement to an Indian fancier who came all the way from the United Provinces."

* * * * *

"The bird that took first prize at the recent Lahore show was an Orpington cock which has since changed hands for Rs. 200."

16. Our district work is of course by far the most important of all our activities. Discoveries at Lyallpur or elsewhere are of no practical use unless they are brought home to the cultivators.

District work.

District work is confined to the Chenab colony, where the Professor of Agriculture has charge of it; to the Gurdaspur, Jullundur and Hoshiarpur districts and the Lower Bari Doab colony, in charge of the Deputy Director of Agriculture, Gurdaspur; and the Ferozepore and Hissar districts, in charge of the Deputy Director of Agriculture, Hansi. We also work, but to a less extent, in the Jhelum colony, Gujrat, Sialkot and Attock. Agricultural Assistants are in charge of all the districts and colonies first mentioned. The Sialkot District Board has a farm at Badiana, but hitherto its system of management has been defective, and results consequently very few. Proposals to change it, I hope for the better, are under consideration. The Amritsar District Board has also under consideration a proposal to start a similar farm at Beas. These two farms would be to a certain extent experimental farms, but, to a far greater extent, demonstration farms.

We have a small demonstration farm of about 20 acres near Basal railway station in the Attock district. It is primarily for wheat: the farm is on a five-years' lease, at half batai, and makes a fair profit. Yields this spring, when rain had been so heavy, were not so markedly higher, owing to better cultivation, than those of surrounding fields, as they would be in ordinary years. But they certainly were better. In Ferozepore, where the District Board pays for the Agricultural Assistant, the Guruharsahai and Mamdot court of wards' estates form most useful demonstration farms.

17. An account of these is given in paragraph 28 of last year's report. We have now associations in Gurdaspur, Jullundur, Hoshiarpur, Lyallpur, Gujrat and Ferozepore, and associations are being formed in Shahpur and Hissar. They are continuing to work satisfactorily: and must be regarded as our principal means of agricultural improvement.

Agricultural Associations, demonstrations, etc.

Demonstrations of improved implements were also given at eighteen fairs in the districts we are working in. More could not be attended with our small staff. These demonstrations occasionally result in the sale of a new implement at once, but they do more good in exciting general interest in our activities. Touring parties were sent last year, as a new departure, through Jullundur and Hoshiarpur. A beldar, with a pair of bullocks, and a Rajah plough, or similar implement, toured through many villages, and ploughed up zemindars' land for them with his plough; showing them what much better work the Rajah plough does than the country plough. The zemindar in question, seeing how good the crops are on the land cultivated with the plough we recommend, not infrequently has come to us afterwards and asked us to buy him a similar plough. The lending out of implements to selected cultivators, for a period, which never exceeds a year in any one case, has always been practised by the department in this province. Some 300 implements of sorts are now out on loan.

18. The following table shows that practically all the implements we advocate have increased in popularity in the year under report : the rise in the number of Meston ploughs sold is very satisfactory :—

Implements.	Average number sold per year during each of the last five years.	Number sold during 1914-15.
Rajah ploughs	116	188
Meston ploughs	132	664
Other ploughs	6	16
Hoes	12	12
Harrows	31	35
Fodder cutters	49	60
Total	346	975

There is reason to fear that the war will soon render it difficult, if not impossible, to obtain many of these implements from England : the works of Messrs. Ransome Sims and Jefferies at Ipswich, who make the Meston plough, are practically entirely given up to the making up of munitions. Prices are also rising. Imitation is the sincerest flattery : and blacksmiths in Hoshiarpur, Gurdaspur and Sialkot are now making quite good imitation Meston ploughs, which are naturally cheaper, and worse finished, than the English article. Still they invert the furrow, which is the principal thing. Some hundreds of them are in use. With reference to the remark made in paragraph 5 of the review on last year's report that the "best demonstrator is a cultivator who has himself used an implement and found it profitable," let me quote a couple of cases : I could give many others. Chak 104 S. B., Jhelum colony, is cultivated by Sikhs from Gujranwala. They were originally lent one Rajah plough from the neighbouring Sargodha farm. They have now 8 Rajah ploughs in constant use, and told me that they found one ploughing with the Rajah equal to five or six ploughings with the country plough.

Incidentally this shows that the practice of lending implements to selected zemindars is a good one.

Hirdapur forms part of Ugo Chak village near Gujranwala ; it is in the centre of a tract badly infected with *dab* grass. Some years ago an energetic officer had 35 Rajah ploughs sold in the tract : this plough is undoubtedly most efficacious in removing this grass. The officer was transferred, and the great majority of ploughs were never used—a fact that will not surprise anybody who knows the Punjab. The Hirdapur people, however, persevered, and found the Rajah plough good : and they, though their total area is only 275 acres, have now nine Rajah ploughs in use. Some of these they bought up cheap from the original unwilling purchasers. Ugo Chak, their main village, seeing the Hirdapur crops, has now four similar ploughs, and the example is spreading.

The Sargodha farm adjoins the land of a well-known Indian gentleman of Jullundur. When the department started work there in 1913 he refused to take any advice from it, saying that his tenants knew what was best for them. One year's comparison of his crops and ours has converted him : he now has ten Rajah ploughs and four spring-tined harrows in use, and also only allows our wheat and cotton to be grown on his land.

Punjabi proverbs often contain in a pithy form the views of the village. Here is one that has recently come into being in some Jullundur villages—

راجہ هل دی باہی — پوسہ کنگ دی بجائی
چین ہیرو دی پھرالی — ھے پوری بادشاہی

which may be translated as, "ploughing with Rajah plough, sowing of Pusa 12 wheat, and the use of the chain harrow brings the wealth of a kingdom."

Twelve village and union banks in the Jullundur, Gurdaspur and Hoshiarpur districts have undertaken the sale of agricultural implements at 5 per cent. commission. The point is dealt with in more detail later.

All the purchasers of improved implements are visited at intervals by an Agricultural Assistant, who gives them any advice or help he can in its use.

The Sialkot District Board are paying half the cost of 14 Rajah ploughs to zemindars. As the initial expense of the plough is Rs. 27, considerably more than the *desi* plough, the example is to be commended : but it should not of course be carried too far.

19. Partly as a result of last year's efforts, and partly owing to the high price of labour in the colonies owing to plague, there was a brisk demand for reapers this spring to cut wheat : Messrs. Volkart Brothers sold all the thirty they had in stock, and could have sold more had they been procurable. Some old reapers in chaks 207 and 199, Rakh Branch, of the Chenab colony, which had not been worked for 2 or 3 years, were bought by enterprising zemindars of Chak 208, Rakh Branch, at reduced prices, and successfully worked. It is estimated that about 150 reapers in all were used this harvest. Assistance was as usual given by the department, and was freely asked for, especially by new buyers. The sharpening of knives at the college workshop was in such demand that it will be charged for in future. As said last year, the reaper, though it costs Rs. 255, is a most economical machine in canal irrigated tracts, and is steadily increasing in popularity. I hope M. Charan Singh will be able to induce some of the new colonists in Montgomery to purchase a few.

As to threshers there was a keen demand for the service of the steam-thresher at Lyallpur this year, doubtless owing to the same reasons as caused the demand for reapers. The Professor of Agriculture is preparing a note on the subject. The highest outturn was 160 maunds per day, which is an improvement on previous years. Four annas a maund was charged, which is about the maximum the zemindar can pay : with a short season of two months, it is doubtful if the work can be done at this price without losing money, when the capital cost of the machine is taken into consideration.

The Gurdaspur thresher was hired to a neighbouring zemindar : there were other applicants for it, but they could not wait. The bhusa continues to be very coarse. It is intended next year to try this thresher in the Jhelum colony.

20. The following areas in acres were last rabi under wheat we had distributed—

Wheat.

Type of wheat.					Punjab 11.	Punjab 13.	Punjab 14.	Pusa 12.
District.								
Jullundur	...	...	...	...	...	...	225	170
Hoshiarpur	...	...	...	...	...	3	125	144
Gurdaspur	...	...	...	...	...	700	85	375
Gujrat	...	...	...	...	2	3	3	3
Shahpur	...	...	...	...	635	...	...	...
Chenab Colony	...	...	...	...	6,000	...	...	10
Total					6,637	706	438	702

This seed used in Shahpur and the Chenab colony came from the Sar-godha and Lyallpur farms. The arrangement under which the greater part of the remainder was grown is described in paragraph 30 of last year's report.

The merits of Punjab 11 and Pusa 12 have already been discussed. Punjab 14 gave poor results and is being discarded. Punjab 13, though this year it did not do well owing to the rainy season, has its patrons, especially in low-lying land, and is being continued. Pusa 12 was popular everywhere. Punjab 11 did very well in the colonies. It is merely the predominant local variety grown pure.

The greater part of the Punjab 11 and Pusa 12 wheats, and a small amount of Punjab 13 is being kept for sowing this autumn. We hoped that co-operative societies would take the greater part of this from us, but we were very much handicapped by (a) the unsatisfactory financial condition of many of the societies and (b) the fluctuation in the price of wheat, and uncertainty as to its future course, which caused many societies to decline to consider the proposal. Thus the central bank at Lyallpur, which had bought 1,500 maunds of wheat from us in previous years, this spring declined to buy any. The difficulty was got over in the Chenab colony to some extent by sales to individuals; one prominent member of that bank bought 4,000 maunds. Other parcels of our Punjab 11 the department purchased, and the Professor of Agriculture hopes to have at least 18,000 acres under Punjab 11 in the colony this winter.

In Jullundur, Gurdaspur and Hoshiarpur I had an Assistant Director touring in the spring to arrange for the cleaning, purchase and storage of our wheats. He worked in close co-operation with the banks; but the work was more difficult than usual for the reasons already given. In nearly all cases those who had grown our seed were so pleased with it that they are keeping it all to sow themselves, or to sell to others for the same purpose this rabi. In some cases, the banks advanced the growers money on its security: in some, the banks purchased the grain themselves, and will sell it for sowing this rabi. Over 2,300 maunds are thus stored, after being properly cleaned, in the three districts just mentioned: and about the same amount is being stored in Jhelum colony.

Our wheats are not yet grown in sufficient amounts to be placed in the market for ordinary export sale. Wheat better and cleaner than the average gets no higher price unless in large quantities: though even now our growers generally can get 2 annas a maund for our wheat above the ordinary market price. Our efforts at present are devoted to the extension of our area to so large a figure as to enable us to put large parcels of wheat on the market.

In Ferozepore, where work is commencing, 125 maunds of selected seed will be sown this rabi. Constant care and attention is always required from members of the department to get the wheat properly rogued and cleaned: and this will be the case, I imagine, for many years to come.

21. As to country cotton, we had only a small area under selected *Gossypium sanguineum*. The position as regards American cotton is much more satisfactory. In 1914 over 2,000 acres of 4 F. American cotton were grown from seed we sold in the Chenab colony: and about 400 acres in the Jhelum colony. The produce (the sale of which the department supervised) fetched a premium of between Rs. 2-5-0 and Rs. 2-8-0 a maund over country cotton. The areas under this cotton this year have been considerably increased: it is estimated that about 6,000 acres is under this cotton this year in the Chenab colony, and 1,500 acres in the Jhelum colony, in addition to a small area in Montgomery. The increase would have been greater, but for the general decrease in cotton cultivation owing to the fall in price.

The system we follow in the growth and ginning of this cotton is that described in paragraph 30 of last year's report.

22. In addition to the three principal lines of district work—sale of improved implements, and the growth of improved wheat and cotton seed—
 General. with which I have dealt, we have many additional activities in districts—they may be called side lines—which can only be enumerated here. The following are a few of them :—

Ensilage experiments.—These were tried at the farms, and in a few villages in Jullundur, Gurdaspur and Shahpur. They were successful, and will be continued : but the remarks of the Professor of Agriculture on the subject on page xxix of appendix VI are worthy of note.

The sowing of cotton and maize in lines, and subsequent interculture.—This is a very promising line of action, over which the Professor of Agriculture is very enthusiastic. It is certainly increasing in popularity. The harrowing of wheat and sugarcane : deep ploughing for cane : green manuring in the Chenab colony—(this gave good result this year) : and the growth of Japan sarson for fodder, are the principal other minor reforms we inculcate in districts.

23. It is a commonplace of the latest literature on the subject, not only in India, but all over the world, that the co-operative movement is a most useful handmaid to agricultural improvement. This is fully realized by all the members of the department in this province : but this year we were very considerably handicapped in our efforts to use the co-operative societies by the exceptional circumstances, both of the year and of the societies themselves. These I have already indicated, and will not repeat them. Some 12 villages and union banks in Jullundur, Gurdaspur and Hoshiarpur, are, as I have already said, stocking our implements for sale. They get 5 per cent. commission from the makers. It is hoped that other banks will take up the work as their circumstances improve. Some banks have also purchased and are storing our wheat : this is very common in the Shakargarh tahsil of Gurdaspur, where repayments of loans are generally made in grain. Other lines of activity in which the banks can help us are in addition to these (a) the keeping of a mowing machine for use by its members, and other of the more expensive implements, which an ordinary zemindar thinks twice before he buys : (b) the erection of small cotton ginneries : (c) tube-well installations, by which the land of many members would be irrigated : (d) the extermination of *pohli* (something has already been done in this). When we get to the stage of putting our wheat in the market, use will, it is hoped, be made of the shops at Phillour, and Pattoki (Chunian colony) which belong to co-operative societies.

I am inclined to differ from my predecessor as to whether we should have co-operative societies purely for agricultural purposes, quite separate from the existing societies, or whether we should make use of the latter. He thought we should have entirely separate agricultural societies. The principal reason for my view is that the existing societies are to a large extent “one man” societies : but that “one man” is the very man we want to use : he will, from the nature of things, be generally the most enterprising and intelligent zemindar in his neighbourhood. But even he can be overburdened. And to run two societies instead of one might prove to be the proverbial “last straw.”

24. The Lyallpur and Gurdaspur farms are steadily getting better known throughout the province, and every encouragement is given to visitors of whom larger numbers visit them every year.
 Conclusion.

The staff, both officers and subordinates, worked well through the year.

I am sorry this report is a few days late.

C. A. H. TOWNSEND,

15th September 1915.

Director of Agriculture and Industries, Punjab.

APPENDICES.

APPENDIX I.

Report of the Principal, Punjab Agricultural College.

THE sixth session of the Punjab agricultural college opened on the 20th July 1914 and has been one of some importance in the history of the college, for in it the old three years' syllabus was brought to a close in the diploma examination held in April 1915, and a new syllabus inaugurated of a four years' course divided into two parts.

As I have already reported in the past, there has been, since the opening of the college in 1908, a steady decline in the number of applications for admission, culminating in the crisis of 1913 when no new class could be formed. This difficulty I attribute to the want of proper employment on an adequate rate of pay for the holders of the college diploma, and the apparent unpreparedness of the province for technical education of the standard given. These difficulties have been met in part by raising the pay of assistants employed in the agricultural department and lowering the cost of agricultural education without any corresponding reduction of its standard: in part by dividing the course into two parts each of two years' duration. In the first part has been included practically all the agricultural tuition previously given in the old three years syllabus at the expense of instruction in the sciences. I have also included courses in English and arithmetic in the first part, as my experience has shown the necessity of further tuition in these subjects for the students entering the agricultural college. The second part of the course will include instruction in the sciences appertaining to agriculture, and will not come into operation until the session 1916-17.

The change in the syllabus, the improved prospects for students, and the lowering of the cost of education have all operated beneficially on recruiting, and I was able to form a class from 58 applicants of 23 students by the middle of October 1914. There was a great deal of reserve in candidates coming forward at the opening of the session owing, I believe, to a general want of information regarding the course, its cost, and the prospects of the students, for I had to start the class with only four scholars. I consequently wrote a short description of the new course for the press, both English and Vernacular, at the end of July 1914: this had the desired effect of inducing students to come forward. I was not able to complete a class however until the middle of October. Difficulty is always experienced in getting the students to attend the college promptly at the opening of the session in July: invariably a number of candidates who have obtained permission to join the course fail to put in an appearance when the college opens. It is too early to say yet that the new course is a success, for this only time can prove; but so far as can be seen at present the new syllabus seems based on a better system than the old one and is more popular.

We seem to have turned the corner and I believe the college will never again have to face such difficulties as it experienced in 1913. In addition to the new syllabus another new departure was made this session in extending the class for Assistant Commissioners in Indian rural economy so as to include a number of canal officers, Extra Assistant Commissioners and canal zilladars. This class was held from 1st March to 1st April 1915 and was attended by 20 students. The instruction in this class is given in English and for the most part by the Professor of Agriculture. The attendance of the class was regular and the students worked hard. Sixteen students attended the 6 months' vernacular class. They were the best type of student for this class of instruction, all sons of zemindars. They all refused any offer of employment at the end of the course, and with two exceptions went back to their homes to farm work. Two of the students asked to join the first part of the diploma course. I admitted one.

The following table gives the classified list of students attending the agricultural college in 1914-15:—

Europeans	...	...	...	...	8
Muhammadans	...	...	...	...	16
Hindus	...	...	...	...	28
Sikhs	...	...	...	...	23
			Total	...	75

Diploma Examination.—The fourth diploma examination was held from April 19th to May 2nd, 1915. Thirteen candidates presented themselves for examination and all passed. The average ability was much higher than in the two previous years, but the examiners reported that the candidates were especially weak in English. External examiners assisted the college professors at this examination.

Scholarships.—As candidates were not forthcoming for the scholarship examination in 1914, the ten Government scholarships of Rs. 6 per mensem each were granted at the end of the winter term for general progress and ability.

On May 8th, 1915, an entrance scholarship examination was held in the agricultural college. Twenty-two nominations were received and 18 candidates presented themselves for examination.

The following table gives the number of applications for admission this spring, together with the provincial division or state from which the applications have been received :—

Name of division or province.	Nominations for Entrance Scholarship Examination.	Applications for admission as ordinary fee paying students.	Total.
Ambala	5	4	9
Jullundur	4	29	33
Lahore	9	30	39
Multan	2	12	14
Rawalpindi	2	11	13
North-West Frontier Province ...	...	4	4
Native States	...	4	4
Other Provinces	...	4	4
Total	22	98	120

During the year I have put into operation Government orders contained in their letter No. 355 Rev., dated 4th December 1914, and the vernacular class students are now charged an inclusive fee of Rs. 5 per head for hostel accommodation, board and tuition.

As this aid is only granted to non-scholarship-holders, and as there were only three such boys in the class this year, I do not propose to report on the efficacy of the system this year. I consider this subsidy is justified for the present and should be continued for the next five years. If during that period the popularity of the class increases greatly, or if private donation in the form of scholarship grants are forthcoming from public-spirited persons, this Government subsidy might be gradually withdrawn. Some signs of this are already visible in the action being taken by District Boards and private donors, who have offered over 40 scholarships to be held in the vernacular class this winter.

The Government research scholarship was awarded to Kartar Singh who is now engaged in studying modern dairying and the milk supply of Indian cities. An account of his progress will be found under the Professor of Agriculture's report for the year. The subject for post-graduate study this year is at present under consideration.

College buildings and equipment.—One of the most important part of the college equipment, and one of the most unsatisfactory, is the college water-supply. It has been wholly insufficient for our requirements for several years past, and various suggestions have from time to time been put forward for its improvement. The water at present in use is supplied by the Lyallpur Municipality and some serious mistakes were made in laying down the pipe line in the first instance. As the cost of putting this matter right is likely to be high, I have under consideration an alternative scheme for supplying water from a deep tube well in the estate. The local water has been examined and is satisfactory, and the cost of installing the plant and raising the water is being worked out by the Agricultural Engineer. I think this will give us a solution to the water difficulty.

Various constructional works have been undertaken or completed during the year.

One important item in the addition to buildings has been an extension of the college workshop in the form of sheds to accommodate a class in practical workshop instruction. This class commenced on the 20th of July 1915. Mr. Brownlie, the Agricultural Engineer, also gave some lectures towards the end of last session.

Another serious breakdown in the second generating set of the electric plant occurred in August 1914. The first engine has been received back after repair from the makers, but is not now as powerful as demanded in the original specification. I had the plant tested by

the Government Electrical Inspector and am referring the matter to the Legal Remembrancer. These engines, which were supplied by Bellis and Morcome, have been most unsatisfactory, and have given nothing but trouble since their installation.

Hostel, Clubs, &c.—The general health of the students has been good and there has been no serious disorder during the year. We are once more in sight of the necessity of increasing the hostel accommodation. I shall make provision in the budget of 1916-17 for this, and in the meantime am waiting to see how many applications for admission we receive in June 1916 and how many of the students of the first part remain for the second diploma course before commencing to build.

The college societies and clubs have continued in a satisfactory manner and the staff have taken a greater interest in the social life of the students than has been the case in previous years. This latter is essential to the success of the college, and helps materially in rendering it popular.

Staff.—Mr. D. Milne was on six months' leave from 23rd May 1914 to 15th December 1914, the Assistant Professor, Lala Jai Chand, acting as Economic Botanist during his absence.

Mr. A. J. Grove, Supernumerary Entomologist, made over charge on 26th April 1915, after completing his studies of the life history of the insects affecting stored wheat in the province.

Mr. T. M. Brownlie, Agricultural Engineer, joined his appointment on 13th February 1915, and took charge of the college workshops.

Mr. O. T. Faulker joined the Department as Deputy Director of Agriculture on 14th October 1914. Since 8th April 1915 he has been in charge of the college office, and has relieved me of a good deal of office routine.

M. Barkat Ali, assistant in the Chemical Section, returned to Lyallpur on 23rd August 1914, after completing his training in soil bacteriology at Pusa.

Mr. B. S. Mehta, Demonstrator in Chemistry, was appointed research assistant in chemistry from 1st August 1914.

Expenditure.—The expenditure on the college during the past year has been :—

	Rs.
Pay of officers and establishment	53,433
Travelling allowances	9,138
Contingencies	93,384
Total	1,55,955

That of the past five years has been as follows :—

1910-11	90,564
1911-12	92,517
1912-13	98,277
1913-14	1,10,593
1914-15	1,55,955
<i>Income.</i>	
	Rs.
1910-11	3,818
1911-12	8,290
1912-13	11,739
1913-14	7,553
1914-15	9,088

The increase in expenditure is due to the Narwala reh farm equipment and expenses.

In conclusion I have pleasure in stating that the college has had a satisfactory year on the whole, and that the new syllabus is working smoothly and gives promise of being both popular and useful.

J. H. BARNES,

Principal, Punjab Agricultural College, Lyallpur.

APPENDIX II.

Report of the Agricultural Chemist.

Staff.—Mr. B. S. Mehta was appointed Research Assistant in Chemistry on 1st August 1914. A second vacancy was temporarily filled by H. D. Warden from Bombay, but he was dismissed as unsatisfactory. The appointment has now been filled by one of the Punjab Agricultural College graduates, Mukand Lal, on probation. He joined on 19th July 1915. Barkat Ali L. Ag. Bacteriological Assistant joined on 23rd August 1914 after completing his training at Pusa.

Provincial work.—The provincial work, mainly of a consultant nature, has shown an increase of 53 per cent. over that of 1913-14: two hundred samples of soils, waters, manures or agricultural products being analysed and reported upon, as against one hundred and twenty-seven samples tested in 1913-14. This increase in the output of the laboratory has extended to the research side also, and is due to the greater leisure afforded by a shortage of students and the consequent reduction of the time devoted to teaching.

Investigations.—Several important investigations have been in progress during the year and have yielded results of value.

Wheat weevils.—The joint work of Mr. A. J. Grove and myself was completed in May, and the results in the form of a Memoir submitted for publication. The results obtained include a detailed study of the life history of the principal insect pests infecting stored grain in the Punjab (by Mr. Grove). Our joint studies point to a mechanical method of separation of the insects and larvæ as the only feasible way of combating these pests on a large scale in wheat granaries.

The chemical enquiries showed that the three principal insects (or their larvæ) are highly resistant to the asphyxiating effect of chemically inert gases, and this has led to the discovery of the presence of powerful oxidising ferments which play an important rôle in the process of respiration. These have been shown capable of bringing about the oxidation of food substances after separation from the animal as a living organism, as well as the cleavage of food substances rich in oxygen by their means when the supply of atmospheric oxygen is either restricted or withdrawn.

Our results fail to confirm those of Lefroy and Fletcher with regard to the immunisation of wheat by drying, though the moisture contents of Punjab wheats lie within the limits laid down by these authors. Our results show—as indeed we expected they would—that wheat takes up little or no moisture by absorption from a moist atmosphere.

Other subsidiary investigations in connection with the same problem have shown that carbon dioxide has a marked effect on the vitality of stored wheat, the germinating power being rapidly destroyed. This has been shown to be due to the life processes being forced to depend upon the cleavage of food substances in the embryo, a process eminently wasteful of the energy of the food when compared with that of oxidation or respiration usually taking place in properly aerated seed. The amount of carbon dioxide given out by wheat in the course of its germination under conditions of complete and restricted aeration have shown the importance of cultivating and fully aerating the soil during germination in order to take full advantage of the water supply, and the food substances in the embryo and in the seed, and so obtain rapid and healthy growth of the young plant.

Narwala experiment in reclaiming alkali land.—In this experiment our object has been the removal of the excess of saline matter from the soil by lateral drainage. The drains were made with a mole plough using a Fowler's steam engine of 40 H. P. In the experimental stage we have used only a single engine with double cables and moveable anchor waggon, an obsolete form of steam cultivation, but adopted in this case to lower the initial cost of the plant required for the experiment. The drains were made to discharge into an open channel running the entire length of the farm.

In addition to this, the effect of deep cultivation with steam machinery was tried, as my preliminary physical investigations showed this to be a likely method of accelerating the leaching process. Cultivation and draining with the steam tackle proceeded during the months of April, May and June, and was followed by liberal flooding with water; the actual amounts given may be seen from the table at the end of this report. The entire farm was sown with wheat in the autumn. The results were good beyond expectation because the amount of water applied to the surface of the land was insufficient to induce lateral drainage and the central drain remained practically dry throughout the summer, and also because many of the lateral mole drains were destroyed by expansion and contraction of the soil in the dry hot weather.

Taking the whole farm I reduced the area affected by salts (that is barren soil) from 47·96 acres to 3·77 acres, and our yields of wheat were :—

			In maunds per acre.	In bushels per acre.
Highest	...	...	26·5	36·2
Lowest	...	...	13·44	18·4
Average	...	...	18·59	25·4

reckoned on the whole area, and including that lost to crop in khals and bunds. These yields are a marked advance on any in the district or in the Province. The wheat grown was Punjab type 11. Even on the area still too saline for the wheat to germinate a bacteriological examination of the soil showed that a considerable improvement had been effected by the treatment.

I consider from these experiments that the method is likely to be successful, and that in many reh soils deep cultivation alone combined with surface flooding and an open drain will suffice for the reclamation of the land for agricultural purposes. In other stiffer soils sub-soil drainage will have to be resorted to. The exact cost of this is not yet determined. The figure showing the actual cost in the tabular statement at the end of this report must be taken as higher than would be the case when working the scheme on a business basis, for we should then use the double engine system, and instead of averaging about six acres a day (our highest with the single engine and double drum system at Narwala) we should be able to do about 26 to 30 acres a day at only double the cost in fuel, oil and mechanics' wages. Though the experiment is not yet complete I have good reason to believe that this method of reclaiming alkali soils will prove a success and a commercial possibility in canal irrigated lands. After completing some further experiments in back flooding to accelerate lateral drainage, I propose to turn next to the reclamation of alkali lands by well water and at the same time to work out the actual economics of the double engine system. I am already in consultation with the Agricultural Engineer regarding this, and shall inspect a badly affected tract of land between Gurdaspur and Amritsar districts where no canal water is available, but where, he says, he could raise water from the sub-soil at a remunerative rate. A full and detailed report of the Narwala experiment will be published in 1916.

Sugarcane in the Gurdaspur district.—The survey of the Gurdaspur canes started in 1911-12 has been completed and a report of the whole work will be published towards the end of the summer 1915.

Briefly summarised, these results indicate that the canes of the district are a degenerate type as a result of climatic disadvantages. There is no likelihood of the district ever growing canes for the manufacture of refined sugar: Gurdaspur is too far north and the cane is in consequence invariably subject to attacks of frost. A detailed study of this effect of frost on different varieties of cane has been carried on for the past three years at Gurdaspur, and a separate publication on this aspect of the sugar problem in the Punjab will be issued shortly.

In addition to the sugar work in Gurdaspur, I have during the present year under report commenced surveying the canes of the southern Punjab. I find the canes of parts of Karnal so immeasurably superior to those in Gurdaspur that I am inclined to think we have put our sugarcane farm in the wrong place. The yield of cane at Manana (Karnal) is about 80 per cent. higher than the average in Gurdaspur, and the purity of the juice apparently unaffected by frost. This enquiry will be continued.

Java seedling No. 105, which I introduced into the Punjab from Egypt in 1913, did so badly at the Lyallpur farm last year that I removed the crop to Gurdaspur, where it showed excellent growth by the end of July 1915.

Tea.—Last summer I visited the Kangra valley and met a number of the tea planters with the object of inducing some of them to take up the manufacture of brick tea for the Thibetan trade. A number of samples of brick tea were made in several factories both by myself and by some of the planters, which were in many cases a superior article to that commonly found in Thibet. Analysis of these coarse Thibet teas show that they are not, as commonly believed, adulterated with foreign leaves but are of coarse quality—evidently often nothing but tea bush prunings—and are sometimes adulterated with partially exhausted leaf. I have inspected some of the principal tea gardens and factories of the valley, and am instituting manurial experiments there this year.

From what I have seen I consider that this industry is worth the sympathetic support of Government. It has suffered very badly in the past and after the great earthquake of 1904 the whole industry practically changed hands, the present owners being quite inexperienced in either growing or making tea. The result has been a falling off in the quality of the tea produced. I have seen teas of excellent flavour produced where sufficient care has been given—there is no doubt that the climate is favourable and that the soils in certain parts of the valley are well adapted for the growth of tea of a high quality and can be improved by artificial manures. But a large quantity of rubbish finds its way out of the valley under the name of tea which tends to degrade the whole produce of Kangra in the eyes of the public. I hope to find an outlet for the poorer qualities of tea in brick form for the cheaper markets of Spiti Lahul and Thibet.

In connection with the same subject a number of adulterated teas were examined for Government. The adulteration was not merely of the most gross type, involving the addition of earth to the extent of nearly 40 per cent. in one case but also included such refinements as the colouring of the tea artificially with a yellow aniline dye (Heli anthine) and the strengthening of the astringent properties by the addition of catechu (a tanning material). I have reported on this case, and suggested protective legislation on the line of the British Food and Drugs Acts of 1875-76.

Bacteriology.—The effect of the treatment given in reclaiming alkali soils at Narwala on the bacterial flora present in the barren portions have been kept under observation.

The organisms responsible for both nitrogen fixation and for the oxidation of organic matter appear to be present in these barren soils, but in a very inactive condition. They rapidly regain their activity when the land is opened up and washed with water and this is apparent even before the land is sufficiently improved to bear a crop. The same applies to the results obtained with the organisms responsible for ammonification and nitrification. The ammonification organisms show an abnormality as compared with the same organisms in fertile soils. This matter is under further investigation (see tables in the appendix).

Phosphatic manures.—During the year I have made some enquiries into the export trade in bones from the Punjab; and I find that these are purchased entirely for the glue and gelatine trades.

As the principal manurial deficiency in the Punjab soils is in phosphates I have suggested the prevention by legislative measures of this export trade in raw bones and the establishment under Government subsidy of bone factories where the glue can be extracted and sold in a crude form for export and the steamed bone meal retained for sale within the province at a cheap rate. The deposit of mineral phosphates in the Salt Range has proved insufficient for the establishment of an industry on a commercial scale.

J. H. BARNES,
Agricultural Chemist, Punjab.

Key to the tables of Biological (Bacteriological) analysis of Narwala soils.

1. The figures in bold type show the bacterial activity in barren soils. As these lands have been lying waste for a long time the remarkable inactivity of bacteria is seen and can be taken as typical of such barren soils.

2. The figures in ordinary type indicate the activities of soil flora after drainage with canal water. These samples were barren to start with and their biological analysis were similar to that shown in bold type before treatment with water.

Milligrams of free nitrogen of the air fixed by Azotobacter, etc., for one gram of Mannite in Narwala soils.

Description of soil sample.	Milligrams of nitrogen fixed after deducting the control.
Typical barren soil	0.73
<i>Normal soil.</i>	
Square No. 2, field No. 2 	12.32
<i>Sterile soil.</i>	
Square No. 2, field No. 2 	9.66
<i>Normal soil.</i>	
Square No. 2, field No. 7 	11.52
<i>Sterile soil.</i>	
Square No. 2, field No. 7 	10.66
<i>Normal soil.</i>	
Square No. 3, field No. 2 	11.08
<i>Sterile soil.</i>	
Square No. 3, field No. 3 	8.82

Note.—The amount of aerial nitrogen fixed by Reh soils after treatment is equal to ordinary normal soils.

Milligrams of nitrogen produced as ammonia in Narwala soils in 100 grams of soil to which 60 milligrams of nitrogen in the form of oil free rape cake was added: moisture used in these soils in the experiments was one-third of saturation capacity—

Description of soil sample.	MILLIGRAMS OF NITROGEN PRESENT IN SOIL AT THE END OF EACH WEEK.			
	1st week.	2nd week.	3rd week.	4th week.
Typical barren soil ...	0.70	0.56	2.9	4.26
<i>Normal soil.</i>				
Square No. 2, field No. 2 ...	30.98	19.04	15.30	1.49
<i>Sterile soil.</i>				
Square No. 2, field No. 2 ...	14.56	17.16	15.68	11.94
<i>Normal soil.</i>				
Square No. 2, field No. 7 ...	26.13	18.66	11.20	1.49
<i>Sterile soil.</i>				
Square No. 2, field No. 7 ...	19.78	17.92	26.13	23.80
<i>Normal soil.</i>				
Square No. 3, field No. 2 ...	22.40	18.66	11.20	10.82
<i>Sterile soil.</i>				
Square No. 3, field No. 3 ...	18.66	21.28	16.42	15.68

NOTE.—Generally speaking the amount of ammonia should be at a maximum figure in the first and second week, and should decrease only in abnormal cases. These reclaimed alkali soils show a departure from this.

Milligrams of nitrified nitrogen (nitric and nitrous acids) formed in Narwala soils from 100 grams soil and 60 milligrams of nitrogen added as oil free rape cake. The moisture contents of these soils in the above experiments was one-third of saturation capacity—

Description of soil sample.	WEEKLY QUANTITIES OF NITRIFIED NITROGEN (AS NITROUS AND NITRIC ACIDS)			
	After 1st week.	After 2nd week.	After 3rd week.	After 4th week.
Typical barren soil ...	0.00	0.00	0.00	0.46, Nitrous nitrogen only.
<i>Normal soil.</i>				
Square No. 2, field No. 2 ...	traces	6.16	14.00	31.92
<i>Sterile soil.</i>				
Square No. 2, field No. 2 ...	0.20 nitrous nitrogen only.	2.24	9.84	15.18
<i>Normal soil.</i>				
Square No. 2, field No. 7 ...	traces	5.60	19.48	37.12
<i>Sterile soil.</i>				
Square No. 2, field No. 7 ...	0.40 nitrous nitrogen only.	3.92	12.08	21.40
<i>Normal soil.</i>				
Square No. 3, field No. 2 ...	traces	4.00	14.72	17.04
<i>Sterile soil.</i>				
Square No. 3, field No. 3 ...	0.30 nitrous nitrogen only.	3.92	7.84	15.20

NOTE.—Generally speaking nitrates begin to appear in normal soils after two weeks, nitrites after a week.

Comparison of C O₂ formation between treated and untreated soils of Narwala farm. (General bacterial activity). The moisture used in the soil in the experiment is one-third of the saturation capacity of the soil.

MILLIGRAM OF C O ₂ GIVEN OUT FROM 200 GRAMS SOIL AND 2 GRAMS OIL FREE RAPE CAKE.																
Description of soil.	After 1st day.	2nd day.	3rd day.	4th day.	5th day.	6th day.	7th day.	8th day.	9th day.	10th day.	11th day.	12th day.	13th day.	14th day.	15th day.	Total.
Typical barren land	2.6	1.70	2.4	1.32	2.2	1.1	1.2	1.43	1.35	1.43	0.55	1.2	1.54	1.43	1.35	23.4
Normal soil.																
Square No. 2, field No. 5	10.78	23.43	100.32	85.58	54.34	62.70	55.12	55.12	63.80	39.82	40.48	41.60	35.42	29.26	25.74	723.5
Sterile soil.																
Square No. 2, field No. 5	3.30	13.86	35.30	42.90	25.30	30.58	22.20	35.20	47.52	46.42	46.62	41.80	45.54	41.58	37.62	515.7
Normal soil.																
Square No. 2, field No. 5	8.14	68.36	99.88	80.30	78.54	66.00	79.66	83.16	81.84	77.44	49.28	44.00	44.00	34.86	30.36	920.8
Sterile soil.																
Square No. 2, field No. 5	2.64	12.10	30.14	44.44	26.18	25.08	32.12	35.42	43.78	43.12	36.08	40.70	38.60	32.56	32.56	475.5
Normal soil.																
Square No. 3, field No. 2	5.72	44.66	92.62	79.20	68.64	66.44	75.90	63.80	65.56	51.92	52.36	42.24	45.62	39.38	30.52	827.6
Sterile soil.																
Square No. 3, field No. 3	2.64	23.32	49.94	40.92	22.88	24.20	33.88	39.16	50.82	50.82	44.88	50.16	38.06	33.22	36.99	540.9

Statement No. I.

STATEMENT OF EXPENDITURE, &c., IN CONNECTION WITH THE NARWALA REH FARM.

Field No.	Area in acres.	Area of barren portion before treatment.	Area of barren portion after treatment.	Treatment given.	COST OF TREATMENT.						Amount of water applied (cusecs).	Yield of crop (wheat and barley).	Rent of land.	Cost of water.	Cost of seed.	REMARKS.
					Agricultural labour.	Cultivation (steam) wages.	Draining (steam) wages.	Fuel and oil.		Draining.						
								Rs. A. P.	Rs. A. P.							
2	235	0 6 15	0 0 11	Cultivated and drained.	35 4 0	7 12 7	4 11 4	14 1 4	12 0 0	7,627	47 2	23 8 0	2 10 3	7 0 9		
1																
2	236	1 4 0	0 1 0	Ditto	35 5 6	7 12 11	4 11 7	14 2 0	12 0 6	7,650	54 33	23 9 0	2 10 5	8 1 1		
2																
2	240	2 0 0	1 0 0	Ditto	36 1 6	7 15 7	4 13 0	14 7 0	12 4 6	9,239	23 7	24 1 0	2 11 3	7 3 6		
3																
2	239	1 7 0	0 2 0	Ditto	34 8 0	7 9 11	4 9 8	13 12 8	11 12 0	8,350	39 22	23 0 0	2 9 6	6 14 4		
4																
2	262	2 0 0	0 2 0	Ditto	39 6 0	8 11 2	5 4 0	15 12 0	13 6 0	9,534	37 19	26 4 0	2 15 3	7 14 0		
5																
2	162	0 5 0	Ignorable	Ditto	24 6 0	5 6 2	3 4 0	9 12 0	8 4 0	5,902	28 20	16 4 0	1 13 3	4 14 0		
6																
2	231	2 0 0	0 2 10	Ditto	33 12 0	7 10 7	4 10 1	13 14 0	11 13 0	8,399	37 18	23 2 0	2 9 9	6 14 11		
7																
2	241	1 5 0	0 1 0	Cultivated but not drained.	36 3 0	7 15 11	...	14 7 7	...	8,762	41 9	24 2 0	2 11 5	7 3 9		
8																
2	210	2 1 0	0 5 4	Cultivated and drained.	36 0 0	7 15 3	4 12 10	14 6 4	12 4 0	8,717	32 20	24 0 0	2 11 1	7 3 2		
9																
2	239	1 0 0	...	Ditto	35 14 6	7 14 11	4 11 7	14 5 9	12 3 6	8,694	52 20	23 15 0	2 10 11	7 2 11		
10																

3 1	193	1 5 8	0 2 0	Drained only	33 9 0	...	3 14 1	...	6 8 7	7,037	29 30	23 4 1	2 2 10	5 12 11
3 2	239	2 0 0	0 3 0	Ditto	41 14 6	...	4 11 7	...	8 1 3	8,694	38 11	28 11 8	2 10 11	7 2 11
3 3	242	1 3 0	...	Cultivated only.	35 4 6	8 0 3	...	8 7 4	...	8,784	44 4	29 0 6	2 11 6	7 4 0
3 4	262	0 6 0	...	Cultivated and drained.	39 6 0	8 11 2	5 4 0	9 2 0	8 13 9	9,534	48 26	31 8 0	2 15 3	7 14 0
3 5	242	1 2 0	...	Ditto	36 4 6	8 0 3	4 13 6	8 7 4	8 2 7	8,784	42 11	29 0 6	2 11 6	7 4 1
3	200	2 0 0	0 1 0	Ditto	30 0 0	6 10 0	4 0 0	7 0 0	6 12 0	7,264	30 0	24 0 0	2 4 0	6 0 0
19 1	153	0 4 0	...	Ditto	22 15 6	5 1 2	3 1 0	5 5 8	5 2 8	5,562	40 23	15 5 0	1 11 6	4 9 6
19 2	188	0 7 0	...	Ditto	28 5 0	6 4 0	3 12 5	6 9 8	6 6 0	6,855	29 22	19 14 0	2 2 0	5 10 7
19 3	205	1 0 0	...	Ditto	30 13 6	6 13 0	4 1 11	7 3 0	3 9 0	7,468	37 8	20 9 0	2 5 0	6 2 8
19 4	190	1 7 12	...	Ditto	29 4 0	6 7 4	3 14 4	6 13 0	6 9 4	7,082	40 20	20 8 0	2 3 1	5 13 2
19 5	138	1 3 2	...	Ditto	20 13 0	4 9 6	2 12 5	4 13 8	4 10 11	5,089	22 20	13 14 0	1 9 0	4 2 7
19	028	0 2 5	...	Ditto	4 3 6	0 14 11	0 9 0	0 15 8	0 15 2	1,022	7 5	2 13 0	0 5 0	0 18 6
18 1	169	1 0 15	...	Cultivated only.	16 6 6	3 10 0	...	4 15 6	...	3,972	28 1	13 2 2	1 3 3	3 4 5
18 2	196	1 0 0	Ditto	Ditto	29 8 6	6 8 5	...	8 14 6	...	7,150	40 24	14 10 2	2 3 5	5 14 5
18 3	170	0 4 0	0 0 3	Cultivated and drained.	25 8 0	5 10 2	3 6 6	7 11 0	4 10 6	6,176	29 29	20 6 6	1 14 6	5 1 6
18 4	171	0 5 14	...	Ditto	25 11 0	5 10 10	3 6 11	7 12 0	4 11 0	6,220	29 12	20 8 11	1 14 9	5 2 1

STATEMENT I—CONCLUDED.

Field No.	Area in acres.	Area of barren portion before treatment.	Area of barren portion after treatment.	Treatment given.	COST OF TREATMENT.							Amount of water applied (cusecs).	Yield of crop (wheat and barley).	Rent of land.	Cost of water.	Cost of seed.	REMARKS.
					Agricultural labour.	Cultivation (steam) wages.	Drainage (steam) wages.	Fuel and oil.		Drainage.							
								Cultivation.	Drainage.								
											Rs. A. P.						
18-5	1.64	0 2 0	...	Cultivated and drained.	24 9 0	5 6 10	3 4 5	7 6 0	4 8 6	5,947	29 18	19 10 5	1 13 6	4 14 7			
18-6	2.07	0 0 2	...	Ditto	31 2 0	6 14 0	4 2 6	9 6 0	5 11 0	7,540	31 39	24 14 6	2 5 4	6 8 6			
18-7	2.09	0 2 0	...	Ditto	31 6 6	6 15 0	4 3 2	9 7 6	5 11 9	7,804	33 25	25 2 2	2 5 9	6 4 5			
18-8	2.12	1 7 0	...	Ditto	31 14 0	7 0 8	4 4 0	9 9 0	5 13 1	7,718	31 31	25 8 0	2 6 3	6 6 0			
18-9	2.68	1 1 0	0 1 0	Ditto	40 5 0	8 14 6	5 6 1	12 2 0	7 6 0	9,761	36 5	32 4 1	3 0 3	8 0 11			
18-10	2.84	1 1 0	0 0 15	Ditto	42 9 0	9 6 6	5 10 11	12 13 0	7 12 6	10,305	42 10	34 0 11	3 3 1	8 8 1			
17-1	1.71	0 5 0	...	Ditto	25 12 6	5 11 2	3 7 2	7 12 6	4 11 3	6,242	31 10	20 10 2	1 14 11	8 2 5			
17-2	1.71	0 0 15	...	Ditto	25 12 6	5 11 2	3 7 2	7 12 6	4 11 3	6,242	30 21	20 10 2	1 14 11	8 2 5			
17-4	1.73	...	...	Ditto	26 1 0	5 12 2	3 8 0	7 14 0	4 12 0	6,312	30 14	20 13 9	1 15 3	8 3 4			
17-5	1.63	...	...	Ditto	24 9 0	5 6 10	3 4 5	7 6 0	4 8 6	5,947	24 30	19 10 5	1 13 6	7 14 7			
17-6	1.66	...	...	Ditto	25 0 6	5 8 6	3 5 6	7 8 6	4 9 9	6,062	24 36	20 0 6	1 13 0	8 0 1			

17 7	2'12	Some marshes	...	Ditto	31 14 0	7 5 8	2 4 0	9 9 0	5 13 6	7,718	42 20	25 8 0	2 6 3	6 6 0
17 8	2'06	...	0 0 1	Ditto	30 15 0	6 13 4	4 2 1	9 5 0	5 10 6	7,491	43 20	24 12 1	2 5 1	6 2 11
17 9	2'21	...	...	Ditto	32 8 6	7 3 0	2 5 0	9 12 6	5 15 3	7,379	38 33	26 0 6	2 7 0	6 8 1
17 10	2'09	...	...	Ditto	31 6 6	6 15 0	4 3 2	9 7 6	5 11 9	7,640	33 6	25 2 2	2 5 9	6 4 5
16 6	1'09	1 0 15	...	Ditto	16 6 6	3 10 0	2 3 2	3 9 0	3 12 0	3,972	27 5	10 15 0	1 3 8	3 4 5
16 7	1'37	1 3 0	...	Ditto	20 10 0	4 9 11	2 12 0	4 7 0	4 12 0	4,984	31 24	13 12 0	1 8 9	4 2 0
16 8	1'40	1 3, 0	...	Cultivated only.	21 0 0	4 11 3	...	4 8 10	...	5,064	29 2	14 0 0	1 9 2	4 3 2
16 9	1'35	1 2 16	...	Drained but not cultivated.	24 0 0	...	2 11 4	...	4 10 4	4,907	30 15	13 8 0	1 8 3	4 0 8
16 10	1'15	1 1 6	...	Ditto	21 1 6	...	2 5 1	...	3 15 3	4,201	28 29	11 0 0	1 4 9	3 7 8
16 1	1'18	0 1 10	...	Ditto	21 9 0	...	2 6 1	...	4 1 4	4,313	13 0	11 14 0	1 6 4	2 11 0
16 2	1'28	0 2 5	...	Ditto	22 15 6	...	2 9 1	...	4 6 8	4,653	30 30	12 13 0	1 7 0	2 14 3
16 3	1'33	0 2 14	...	Cultivated only.	23 13 0	4 6 11	...	4 5 8	...	4,582	25 15	13 10 0	1 8 1	3 0 6
16 4	1'31	0 6 0	...	Cultivated and drained.	23 7 0	4 5 1	2 10 1	4 4 4	4 8 4	4,767	23 25	13 2 0	1 7 8	2 15 6
16 5	1'05	0 6 0	...	Ditto	19 9 6	3 8 0	2 1 11	3 7 0	3 10 0	3,837	20 16	10 9 0	1 3 0	2 6 3
Total	95'42	47 7 4 or 47'96	3 6 4 or 3'77	...	1,403 0 6	285 15 6	168 0 5	335 1 4	298 3 2	345,515	1,715 25	1,049 8 2	107 2 6	237 11 10

Statement No. II.

STATEMENT OF RECURRING AND NON-RECURRING EXPENDITURE, NARWALA FARM.

Recurring expenditure.	Amount.	Initial expenditure.	Amount.
	Rs. A. P.		Rs. A. P.
Agricultural labour	1,468 0 6	Digging of roots, &c.	250 12 0
Repairing khals	156 0 0	Karahing land	390 14 0
Supervising bullocks	324 0 0	Making khals	325 13 0
Plastering quarters	15 0 0	Levelling	215 12 0
Miscellaneous	132 8 5	Making temporary bunds	150 0 0
		Filling pits, &c.	225 8 0
Total	2,096 8 11	Total	1,558 11 0

Statement No. III.

STATEMENT OF TOTAL COST OF PRODUCTION PER ACRE PER MAUND.

Area in acres.	Sub-heads.	Amount.	Expenditure per acre.	Expenditure per maund.
		Rs. A. P.	Rs. A. P.	
112	Variable labour	3,600 0 0	32 0 0	
84	Wages for steam cultivation	285 15 6 (a) 902 0 9	14 2 0	
82	Ditto draining	168 9 5 (a) 876 12 0	12 13 0	7,983 Rs. $\frac{1,716}{1,716}$ = Rs. 4-10-4 per maund.
84	Fuel and oil for steam cultivation	395 1 4	4 11 0	
82	Ditto draining	298 3 2	3 10 0	
95	Rent of land	1,049 8 2	11 0 0	
95	Cost of water	(b) 107 2 6	1 2 0	
95	Cost of seed	297 11 10	3 2 0	
	Total	7,983 0 8	82 8 0	

(a) Represents depreciation value of machinery and implements. Machinery was in use for 79 days, viz., 53 days for steam cultivation and 26 days for draining. The machinery could possibly be at work for 300 days in a year.

(b) Water rate for kharif 1914, viz., fodder Rs. 7-10-0 not included in it.

Statement No. IV.

STATEMENT OF SALE PROCEEDS OF CROPS.

3

Variety and weight.	Rate.	Total sale proceeds.	Average rate per maund.
	Rs. A. P.	Rs. A. P.	
Wheat 1,597½ maunds	4 0 0 per maund.	6,390 0 0	} 6,685 Rs. — or 1,716 Rs. 3-14-4.
Barley, 118 maunds	2 8 0 do.	295 0 0	
Total	...	6,685 0 0	

Statement No. V.

STATEMENT OF ESTIMATED EXPENDITURE (WHEAT) 1915-16.

Operation.	Estimated expenditure per acre.	REMARKS.
	Rs. A. P.	
Ploughings (4)	5 0 0	
Sohaga before sowing	0 8 0	
Sowing charges... ..	1 12 0	
Double sohaga after sowing	1 0 0	
Cost of seed	2 8 0	
Cost of watering	2 0 0	
Cost of weeding, &c.	1 0 0	
Cost of harvesting, ...	6 0 0	
Cost of threshing and winnowing	12 0 0	
Rent of land	10 0 0	
Cost of water	1 4 0	
Total	43 0 0	Estimated profit Rs. 29 per acre. ²

APPENDIX III.

Report of the Economic Botanist, Punjab.

Prefatory.—I was on home leave from 24th May 1914 till 15th December 1914. Lala Jai Chand, Assistant Professor of Botany acted for me.

General.—Cottons.—Damage done by a hailstorm on 15th October 1914 reduced the produce by 25 per cent. in some plots to 65 per cent. in others, and made comparison of cropping powers of varieties impossible.

Acclimatised American Cotton.—A few samples of lints of the less damaged varieties were sent to Messrs. Tata and sons, spinners, Bombay, for valuation. A brief extract of that firm's report is as follows :—

Selection No. 282 F is the best cotton sent ; is a very long stapled, strong fibred silky cotton, better than middling American, can spin up to 50 S, value Rs. 310 per candy of 784 lbs.

Selection 72 F is a good long stapled cotton almost equal to middling American ; spins up to 44 S ; value Rs. 300 per candy.

Selection No. III F spins up to 44 S ; value Rs. 300.

Selection 280 F spins up to 44 S ; value Rs. 295.

A number of others were valued from that downwards.

On the same date a sample of unselected acclimatised cotton grown in the colony was valued by Messrs. Tata and sons at Rs. 220 per candy, and was estimated to spin up to 20 S.

With normal freight, the price of middling American on the same date in Bombay would have been Rs. 295 per candy.

We have separated a considerable number of acclimatised American strains, the lints of which have been described at various times by Lancashire authorities as suitable for Lancashire, and several others have been described as better than middling Americans, while unselected cottons of this sort grown here have been pronounced quite unsuitable for these mills. In past years Messrs. Tata and sons have also described these unselected acclimatised American cotton grown in the Punjab as quite unsuited for their mills, while they have offered as much as Rs. 2-8-0 per maund more for our selected sorts. I am informed that in the past year some 2,000 acres of selection 4 F, handed by me to the farm for final testing in 1910, were grown in the colony, and that a premium of about Rs. 2-10-0 per maund over *desi kapas* was got for it. The outturn was also believed to be heavier than in the case of unselected Americans. Besides 4 F several other selections from the botanical section are with the Professor of Agriculture for final tests.

I think work on these acclimatised American cottons is the most promising that I have to deal with. The Secretary of the International Federation of Master Spinners, introduced to me on his third visit to the Province to enquire regarding the possibilities of cotton growing also thought so. He expressed astonishment that such cottons as the selections which I showed him on my lands, could be grown here. As an outcome of our talk on the difficulties connected with getting these cottons grown for the trade he offered to lease 10,000 acres of land—if his committee agreed—on which to grow our best cottons, pure, in quantities which would make them saleable at their real values, and which would form a nucleus for other growers to add to, who would keep their *kapas* pure, instead of being compelled, as they are now, to add their pure lots to the mixtures in the markets. Unfortunately the war has upset this case, I hope something similar will be proceeded with later.

It is also noteworthy that the Manager of the 15th Lancers farm near here has for years now been getting Re. 0-8-0 or more above market rate for his cottons selected under the unofficial guidance of his brother, one of my assistants, and his cotton seeds are in demand by his neighbours. Even selected American cottons are superseding *desi* cottons in Jhang district, and after the war there will be more demand than ever for growing long stapled cottons within the British Empire.

Desi cottons.—Lints from some of the least hail-damaged cottons, separated out of the provincial collection, were also sent to Messrs. Tata & sons. They were priced at Rs. 215, Rs. 185, Rs. 180, Rs. 170, &c., per candy.

G. Neglectum No. 40 has been handed over to the Professor of Agriculture this year for final tests. He has now 5 *desi* varieties for final testing. The work on these cottons has been much delayed owing to practically the whole *kapas* of the collection being stolen from the experimental lands in past years in spite of chowkidaring, and on the last occasion even of police supervision. The lands were completely unfenced, and adjoin the city.

Wheats.—The 25 originally classified types of Punjab wheats.—Appended statements A, B, C, D and E show the comparative cropping and standing powers of these wheats on my lands up to date. The year 1913-14 is omitted as the crops were destroyed by a hailstorm that year.

The outturn equivalent to 100 marks in these statements, for each plot is got after consideration of the quality of the land, the outturn, &c., of the standard plot on either side. Taking the mean of the marks of each type for all these years the types stand as regards comparative outturns in the following order, *viz.*:—17, 9, 4, 18, 16, 11, 25, 20, 8, 15, 21, 19, 24, 5, 14, 22, 7, 13, 23, 6, 1, 12, 3, 10 and 2. Lodging and certain other factors affect these outturns of course.

Of the 25 types, the Compactums (Nos. 4, 5, 6 and 7) stand best of all. The Durums (Nos. 1, 2, and 3) come next, and of the Vulgares (Nos. 8 to 25 inclusive) types 9, 11 and 17 stand best and in the above order. None of these 25 types of wheat will stand however if over 4½ feet in height and their grains are becoming fairly well filled, or even when there is little in the grains if the land on which they are growing becomes well wetted and there is a fair wind blowing.

Regarding rust resistance, types Nos. 11, 14 and 17 are best, and in that order. The Durums (Nos. 1, 2 and 3) are about equal and come next. No. 9 is perhaps the worst rust resister of the Vulgare types and No. 7 (Compactum) is very bad.

New types of wheat.—The 34 new types of the Punjab wheats collected from the wheat surveys of different districts are being multiplied and tested in the same way as the 25 types of the Punjab wheats.

Types Nos. 8A, 8B, 17B and 20C seem most promising so far.

Crosses.—A number of promising crosses are now coming up, but are being held back until we discover which of the many types of wheat which we already have, are the best in different localities, and why.

Barleys and Grams.—The collections of these are being tested after the manner of the cottons and wheats.

Arabian Date Palms.—The question of the quality of fruits which these will bear has now been very satisfactorily settled.

Miscellaneous.—Reports on

- A cause of mixture in pure wheat culture plots,
- Shrivelling of wheat grains,
- Smyrna figs, and
- Tobacco parasite (*Orobancha nivotiana*)

have been sent to the Director of Agriculture.

Ear cockle in wheat and root-rot in cotton have received attention; also oats, Japan rape and other minor crops.

D. MILNE,
Economic Botanist, Punjab.

STATEMENT A.

Showing the relative cropping and standing powers of the 25 originally classified types of the Punjab wheats, year 1909-10.

Relative position of type in the field.	Plot No.	Area in acre.	SOIL.		LODGING.		OUTTURN EQUIVALENT TO 100 MARKS.		Marks obtained by type.	REMARKS.
			Kind.	Further remarks.	Proportion of area lodged.	Date.	Maunds.	Seers.		
IX (Standard)	10	$\frac{1}{32}$	Medium loam	Low land ...	Nil.	...	15	16	66	Spoiled by stagnant water.
I	10	$\frac{1}{32}$	Ditto	Ditto ...	Nil.	...	15	16	62	Attacked by white-ants.
II	10	$\frac{1}{32}$	Ditto	Ditto ...	Nil.	...	15	16	60	Attacked by white-ants.
III	10	$\frac{1}{32}$	Ditto	Ditto ...	Nil.	...	15	16	62	Attacked by white-ants.
IV	10	$\frac{1}{32}$	Ditto	Nil.	Nil.	...	20	0	106	
V	10	$\frac{1}{32}$	Ditto	Nil.	Nil.	...	20	24	96	
IX (Standard)	10	$\frac{1}{32}$	Ditto	Nil.	Nil.	...	20	24	100	
VI	10	$\frac{1}{32}$	Ditto	Nil.	Nil.	...	21	9	80	
VII	10	$\frac{1}{32}$	Ditto	Nil.	$\frac{1}{55}$	17th March 1910	21	34	82	
VIII	10	$\frac{1}{32}$	Ditto	Nil.	$\frac{1}{46}$	Ditto	22	19	94	
IX	10	$\frac{1}{32}$	Ditto	High land ...	Nil.	...	23	4	87	Suffered for want of water.
X	10	$\frac{1}{32}$	Ditto	Nil.	$\frac{1}{50}$	17th March 1910	23	29	84	
IX (Standard)	10	$\frac{1}{32}$	Ditto	Nil.	...	...	24	16	100	
XI	10	$\frac{1}{32}$	Ditto	Nil.	$\frac{1}{40}$	17th March 1910	25	3	88	
XII	10	$\frac{1}{32}$	Ditto	High land ...	$\frac{1}{22}$	Ditto	25	30	70	
XIII	10	$\frac{1}{32}$	Ditto	Ditto ...	Nil.	...	26	17	72	
XIV	10	$\frac{1}{32}$	Ditto	Ditto ...	Nil.	...	27	4	69	
IX (Standard)	10	$\frac{1}{32}$	Ditto	Ditto ...	Nil.	...	27	32	100	
IX (Standard)	13	$\frac{1}{32}$	Sandy loam	Ditto ...	Nil.	...	28	16	100	
XV	13	$\frac{1}{32}$	Ditto	Ditto ...	$\frac{1}{40}$	17th March 1910	28	16	84	
XVI	13	$\frac{1}{32}$	Ditto	Ditto ...	Nil.	...	26	2	92	
XVII	13	$\frac{1}{32}$	Medium loam	Ditto ...	Nil.	...	23	28	93	
XVIII	13	$\frac{1}{32}$	Ditto	Ditto ...	Nil.	...	21	14	98	
XIX	13	$\frac{1}{32}$	Ditto	Nil.	Nil.	...	19	0	110	
IX (Standard)	13	$\frac{1}{32}$	Ditto	Nil.	Nil.	...	19	0	100	
XX	13	$\frac{1}{32}$	Ditto	Nil.	Nil.	...	19	0	84	
XXI	13	$\frac{1}{32}$	Ditto	Nil.	Nil.	...	20	6	90	
XXII	13	$\frac{1}{32}$	Ditto	Nil.	Nil.	...	21	12	90	
XXIII	13	$\frac{1}{32}$	Ditto	Nil.	Nil.	...	22	18	93	
XXIV	13	$\frac{1}{32}$	Ditto	Nil.	Nil.	...	23	24	86	
IX (Standard)	13	$\frac{1}{32}$	Ditto	Nil.	Nil.	...	23	24	100	
XXV	13	$\frac{1}{32}$	Ditto	Nil.	Nil.	...	23	24	87	

STATEMENT B.

Showing the relative cropping and standing powers of the 25 originally classified types of the Punjab wheats, year 1910-11.

Relative position of type in the field.	Plot No.	Area in acre.	Soil.		Lodging.		OUTTURN EQUIVALENT TO 100 MARKS.		Marks obtained by type.	REMARKS.
			Kind.	Further remarks.	Proportion of area lodged.	Date.	Maunds.	Seers.		
IX (Standard)	20	$\frac{1}{32}$	Good loam ...	Nil.	All slightly ...	18th March 1911	21	35	100	There was a rainfall of 2.96 inches at the flowering time.
I	20	$\frac{1}{12}$	Ditto ...	Nil.	All ...	Ditto	21	35	73	
II	20	$\frac{1}{12}$	Ditto ..	Low land ...	Whole crop fell flat.	Ditto	21	37	46	
III	20	$\frac{1}{12}$	Ditto ...	Nil.	All ...	Ditto	22	0	74	
IV	20	$\frac{1}{12}$	Ditto ...	Nil.	Whole crop fell flat.	Ditto	22	3	74	
V	20	$\frac{1}{12}$	Ditto ...	Nil.	Ditto	Ditto	22	6	67	
VI	20	$\frac{1}{12}$	Ditto ...	Nil.	All ...	Ditto	22	10	71	
IX (Standard)	20	$\frac{1}{32}$	Ditto ...	Nil.	Do. ...	Ditto	22	10	100	
VII	20	$\frac{1}{12}$	Ditto ...	Nil.	$\frac{1}{2}$	Ditto	22	10	76	
VIII	20	$\frac{1}{12}$	Ditto ...	Nil.	All ...	Ditto	22	17	81	
IX	20	$\frac{1}{12}$	Ditto ...	Nil.	$\frac{1}{2}$	Ditto	22	25	90	
X	20	$\frac{1}{12}$	Ditto ...	Nil.	All ...	Ditto	22	25	54	
XI	20	$\frac{1}{12}$	Ditto ...	Nil.	Do. ...	Ditto	22	33	76	
XII	20	$\frac{1}{12}$	Ditto ...	Nil.	Do. ...	Ditto	23	1	60	
IX (Standard)	20	$\frac{1}{32}$	Ditto ...	Nil.	A few plants...	Ditto	23	1	100	
XIII	20	$\frac{1}{12}$	Ditto ...	Nil.	$\frac{1}{4}$	Ditto	23	1	73	
XIV	20	$\frac{1}{12}$	Ditto ...	Nil.	$\frac{1}{8}$	Ditto	21	22	72	
XV	20	$\frac{1}{12}$	Ditto ...	Nil.	A few plants...	Ditto	20	4	94	
XVI	20	$\frac{1}{12}$	Sandy loam ...	Nil.	Ditto ...	Ditto	19	5	88	
XVII	20	$\frac{1}{12}$	Ditto ...	Nil.	$\frac{1}{2}$ slightly ...	Ditto	18	6	110	
XVIII	20	$\frac{1}{12}$	Ditto ...	Nil.	$\frac{1}{2}$	Ditto	17	7	88	
IX (Standard)	20	$\frac{1}{32}$	Ditto ...	Nil.	A few plants...	Ditto	17	7	100	
XIX	20	$\frac{1}{12}$	Ditto ...	Nil.	$\frac{1}{2}$	Ditto	17	7	85	
XX	20	$\frac{1}{12}$	Ditto ...	Nil.	A few plants,	Ditto	18	17	104	
XXI	20	$\frac{1}{12}$	Sandy ...	Nil.	Whole crop bent.	Ditto	19	27	89	
XXII	20	$\frac{1}{12}$	Ditto ...	Nil.	Whole crop fell flat.	Ditto	20	37	67	
XXIII	20	$\frac{1}{12}$	Ditto ...	Nil.	Ditto	Ditto	22	7	55	
XXIV	20	$\frac{1}{12}$	Ditto ...	Nil.	All badly ...	Ditto	23	17	69	
IX (Standard)	20	$\frac{1}{32}$	Ditto ...	Nil.	Nil.	...	23	17	100	
XXV	20	$\frac{1}{12}$	Ditto ...	Nil.	All badly ...	18th March 1911	23	17	82	

STATEMENT C.

Showing the relative cropping and standing powers of the 25 originally classified types of the Punjab wheats, year 1911-12.

Relative position of type in the field.	Plot No.	Area in acre.	SOIL.		LODGING.		OUTTURN EQUIVALENT TO 100 MARKS.		Marks obtained by type.	REMARKS.
			Kind.	Further remarks.	Proportion of area lodged.	Date.	Maunds.	Seers.		
IX (Standard)	12	$\frac{1}{32}$	Medium loam	Poor land ...	All types slightly lodged after irrigation on 30th March 1912.	...	30	16	100	
I	12	$\frac{1}{12}$	Ditto	Ditto ...		...	30	16	74	
IX (Standard)	17	$\frac{1}{32}$	Ditto	Ditto ...		...	26	32	100	
II	17	$\frac{1}{12}$	Ditto	Ditto ...		...	27	22	74	
III	17	$\frac{1}{12}$	Ditto	Ditto ...		...	28	12	73	
IV	17	$\frac{1}{12}$	Ditto	Ditto ...		...	29	2	95	
V	17	$\frac{1}{12}$	Ditto	Ditto ...		...	29	32	80	
VI	17	$\frac{1}{12}$	Ditto	Ditto ...		...	30	22	76	
VII	17	$\frac{1}{12}$	Ditto	Ditto ...		...	31	12	74	
IX (Standard)	17	$\frac{1}{32}$	Ditto	Ditto ...		...	32	0	100	
VIII	17	$\frac{1}{12}$	Ditto	Ditto ...		...	31	16	89	
X	17	$\frac{1}{12}$	Ditto	Nil.		...	30	30	86	
XI	17	$\frac{1}{12}$	Ditto	Nil.		...	30	4	98	
XII	17	$\frac{1}{12}$	Ditto	Nil.		...	29	18	89	
XIII	17	$\frac{1}{12}$	Ditto	Nil.		...	28	32	97	
XIV	17	$\frac{1}{12}$	Ditto	Nil.		...	28	6	94	
IX (Standard)	17	$\frac{1}{32}$	Ditto	Nil.		...	27	16	100	
XV	17	$\frac{1}{12}$	Ditto	Nil.		...	27	33	86	
XVI	17	$\frac{1}{12}$	Ditto	Nil.		...	28	10	83	
XVII	17	$\frac{1}{12}$	Ditto	Nil.		...	28	27	96	
XVIII	17	$\frac{1}{12}$	Ditto	Nil.		...	29	4	93	
XIX	17	$\frac{1}{12}$	Ditto	Nil.		...	29	21	86	
XX	17	$\frac{1}{12}$	Ditto	Nil.		...	29	38	84	
IX (Standard)	17	$\frac{1}{32}$	Ditto	Nil.		...	30	16	100	
XXI	17	$\frac{1}{12}$	Ditto	Nil.		...	30	0	84	
XXII	17	$\frac{1}{12}$	Ditto	Nil.		...	29	24	91	
XXIII	17	$\frac{1}{12}$	Ditto	Nil.		...	29	8	89	
XXIV	17	$\frac{1}{12}$	Ditto	Nil.		...	28	32	81	
XXV	17	$\frac{1}{12}$	Ditto	Nil.		...	28	16	87	
IX (Standard)	17	$\frac{1}{32}$	Ditto	Nil.		...	27	36	100	

STATEMENT D.

Showing the relative cropping and standing powers of the 25 originally classified types of the Punjab wheats, year 1912-13.

Relative position of type in the field.	Plot No.	Area in acre.	SOIL.		Lodging.		OUTTURN EQUIVALENT TO 100 MARKS.		Marks obtained by type.	REMARKS.
			Kind.	Further remarks.	Proportion of area lodged.	Date.	Mounds.	Seers.		
IX (Standard)	13	$\frac{1}{32}$	Sandy loam ...	High land ...	Nil.	...	38	16	100	
I	13	$\frac{1}{32}$	Ditto ...	Ditto ...	Nil.	...	37	6	75	
II	13	$\frac{1}{32}$	Ditto ...	Ditto ...	$\frac{1}{4}$	29th March 1913	35	36	61	
III	13	$\frac{1}{32}$	Ditto ...	Ditto ...	$\frac{1}{4}$	19th March 1913	34	26	78	
IV	13	$\frac{1}{32}$	Ditto ...	Ditto ...	$\frac{1}{4}$	28th March 1913	33	16	98	
V	13	$\frac{1}{32}$	Ditto ...	Ditto ...	Nil.	...	32	6	86	
VI	13	$\frac{1}{32}$	Ditto ...	Ditto ...	Nil.	...	30	26	78	
VII	13	$\frac{1}{32}$	Ditto ...	Ditto ...	Nil.	...	29	26	84	
VIII	13	$\frac{1}{32}$	Medium loam	Nil.	Nil.	...	28	16	87	
IX	13	$\frac{1}{32}$	Ditto ...	Nil.	Nil.	...	27	8	100	
X	13	$\frac{1}{32}$	Ditto ...	Nil.	Whole crop fell flat.	28th February 1913 and 29th March 1913.	28	32	54	Germination thick.
XI	13	$\frac{1}{32}$	Ditto ...	Nil.	$\frac{1}{4}$	28th March 1913	30	16	95	
XII	13	$\frac{1}{32}$	Ditto ...	Nil.	$\frac{1}{4}$ badly ...	Ditto	32	0	63	
XIII	13	$\frac{1}{32}$	Ditto ...	Low land ...	$\frac{1}{4}$ th crop bent slightly.	Ditto	33	24	86	
XIV	13	$\frac{1}{32}$	Ditto ...	Ditto ...	$\frac{1}{4}$	Ditto	35	8	88	
XV	13	$\frac{1}{32}$	Ditto ...	Ditto ...	$\frac{1}{4}$	Ditto	36	32	80	
XVI	13	$\frac{1}{32}$	Ditto ...	Nil.	Nil.	...	33	16	106	
IX (Standard)	13	$\frac{1}{32}$	Ditto ...	Nil.	Nil.	...	40	0	100	
XVII	13	$\frac{1}{32}$	Ditto ...	Nil.	Nil.	...	39	27	98	
XVIII	13	$\frac{1}{32}$	Ditto ...	Low land ...	$\frac{1}{4}$	28th March 1913	39	34	94	
XIX	13	$\frac{1}{32}$	Ditto ...	Ditto ...	$\frac{1}{4}$	Ditto	39	31	85	
XX	13	$\frac{1}{32}$	Ditto ...	Ditto ...	$\frac{1}{4}$	Ditto	39	28	76	
XXI	13	$\frac{1}{32}$	Ditto ...	Ditto ...	$\frac{1}{4}$	Ditto	39	25	86	
XXII	13	$\frac{1}{32}$	Ditto ...	Ditto ...	$\frac{1}{4}$	Ditto	39	22	73	
XXIII	13	$\frac{1}{32}$	Ditto ...	Nil.	Nil.	...	39	19	77	
XXIV	13	$\frac{1}{32}$	Ditto ...	Nil.	Nil.	...	39	16	83	
XXV	13	$\frac{1}{32}$	Ditto ...	Nil.	Nil.	...	39	13	81	
IX (Standard)	13	$\frac{1}{32}$	Ditto ...	Nil.	Nil.	...	39	8	100	

STATEMENT E.

Showing the relative cropping and standing powers of the 25 originally classified types of the Punjab wheats, year 1914-15.

Relative position of type in the field.	Plot No.	Area in acre.	SOIL.		LODGING.		OUTTURN EQUIVALENT TO 100 MARKS.		Marks obtained by type.	REMARKS.
			Kind.	Further remarks.	Proportion of area lodged.	Date.	Maunds.	Seers.		
IX (Standard.)	11	$\frac{1}{32}$	Medium loam	...	Whole bent.	crop 12th March 1915	20	32	100	There was a rainfall of 1.98 inches at the flowering time.
I	11	$\frac{1}{32}$	Ditto	...	Whole bent.	crop 12th March 1915	22	30	67	
II	11	$\frac{1}{32}$	Ditto	...	Ditto.	Ditto	23	3	45	
III	11	$\frac{1}{32}$	Ditto	...	Ditto.	Ditto	23	16	55	
IV	11	$\frac{1}{32}$	Ditto	...	$\frac{1}{2}$	Ditto	23	29	102	
V	11	$\frac{1}{32}$	Ditto	...	$\frac{1}{2}$	Ditto	24	2	79	
VI	11	$\frac{1}{32}$	Ditto	...	$\frac{1}{2}$	Ditto	24	15	62	
VII	11	$\frac{1}{32}$	Ditto	...	$\frac{1}{2}$	Ditto	24	28	68	
VIII	11	$\frac{1}{32}$	Ditto	...	$\frac{1}{2}$	Ditto	25	1	74	
IX	11	$\frac{1}{32}$	Ditto	...	$\frac{1}{2}$	Ditto	25	16	100	
X	11	$\frac{1}{32}$	Ditto	...	Whole fell flat.	crop Ditto	25	6	57	
XI	11	$\frac{1}{32}$	Ditto	...	$\frac{1}{2}$	Ditto	24	35	88	
XII	11	$\frac{1}{32}$	Ditto	...	$\frac{1}{2}$	Ditto	24	24	63	
XIII	11	$\frac{1}{32}$	Ditto	...	$\frac{1}{2}$	Ditto	24	13	53	
XIV	11	$\frac{1}{32}$	Ditto	...	Whole crop ...	Ditto	24	2	78	
XV	11	$\frac{1}{32}$	Ditto	...	$\frac{1}{2}$	Ditto	23	31	83	
XVI	11	$\frac{1}{32}$	Ditto	...	$\frac{1}{2}$	Ditto	23	20	82	
XVII	11	$\frac{1}{32}$	Ditto	...	$\frac{1}{2}$	Ditto	23	9	88	
XVIII	11	$\frac{1}{32}$	Ditto	...	$\frac{1}{2}$	Ditto	22	38	95	
XIX	11	$\frac{1}{32}$	Ditto	...	$\frac{1}{2}$	Ditto	22	27	58	
IX (Standard)	11	$\frac{1}{32}$	Ditto	...	$\frac{1}{2}$	Ditto	22	16	100	
XX	11	$\frac{1}{32}$	Ditto	...	$\frac{1}{2}$	Ditto	22	16	95	
XXI	11	$\frac{1}{32}$	Ditto	...	$\frac{1}{2}$	Ditto	22	16	76	
XXII	11	$\frac{1}{32}$	Ditto	...	Whole fell flat.	crop Ditto	22	16	75	
XXIII	11	$\frac{1}{32}$	Ditto	...	$\frac{1}{2}$	Ditto	22	16	67	
XXIV	11	$\frac{1}{32}$	Ditto	...	$\frac{1}{2}$	Ditto	22	16	95	
XXV	11	$\frac{1}{32}$	Ditto	...	$\frac{1}{2}$	Ditto	22	16	108	

APPENDIX IV.

Report of the Assistant Professor of Entomology.

1. *The Sugarcane moth-borers*.—The members of the agricultural associations of Hoshiarpur, Jullundur and Gurdaspur have reported satisfactory results obtained by the "dead hearts" cutting treatment against moth-borers in young canes. The treated crop was heavier and gave larger yields.

2. Last year's work on the different species of cane moth-borers was continued: by the end of this season we shall have a fairly representative collection of them.

3. Moth-borers which attack maize and sorgham were also reared to determine the utility of these crops as traps in sugarcane.

4. *Cotton bollworm and its parasites*.—Last season there was no bollworm trouble. Early broods were destroyed by the good monsoon rains and by September the parasites were spread broadcast.

5. A regular campaign is yearly undertaken against bollworm. The parasites (*rhogas lefroyi*) are grown early in the season and are introduced in cotton tracts of the province by the use of parasite boxes. Last November a parasite breeding plot was started at Hansi. *Rhogas* was found there at the end of May: from June *rhogas* pupae were got from Pusa. The parasite has been thoroughly established in several plots by this time and their distribution will be started where necessary.

6. *Insect pests of cotton*.—A preliminary enquiry into the insect pests of cotton has been made: besides bollworms the other regular pests are:—

I.—Several species of ground grass-hoppers and crickets (not identified yet).

They attack late sown cottons while germinating. The judicious use of field-bags and light-traps has been found effective against them.

II.—Red cotton bug (*Dysdercus Cingulatus*, Fabr.)

III.—Dusky cotton bug (*Orycterus Loetus*, Kirby.)

Their attack is worst from August to November on green and open bolls. The seed is sucked and rendered useless.

Control.—Shaking them off the plants with a jerk into a balti containing water and kerosine oil.

7. *Sericulture*.—Sericulture as a cottage industry has made considerable progress during the year. Last season 539 ounces of seed were reared all told; 374 ounces were distributed by Shaikh Ghulam Sadiq to his professional rearers in the Gurdaspur district. Our distribution was limited to 165 ounces on account of the insufficiency of mulberry trees. The rearings were done in various villages in Sialkot, Hoshiarpur, Ambala, Gurdaspur, Lahore and Amritsar and a good deal of time was spent in getting at the right class of rearers and teaching them the proper management of worms.

8. *Rearing in schools*.—Small lots of silkworms were reared in various village primary schools: where the school masters were keen good results have been obtained and the boys have shown interest in the work.

9. Results of rearings from 515 ounces of seed are available: they amount to a total crop of 85 maunds of dry cocoons, which was sold for Rs. 6,762. The prices realised this year have been below average on account of the war.

10. *The cocoon exhibition*.—The exhibition was held at Gurdaspur on 27th and 28th May. All the produce was collected and judged there. Rupees 209 were given away in prizes. These annual exhibitions serve a very useful purpose in bringing the rearers together. The old Gurdaspur rearers who believed in rearing large quantities of seed are beginning to realise that smaller quantities of seed reared under proper conditions give better outturns and bring in more money.

11. *Mango hoppers*.—These hoppers did much damage in the mango tracts: late in the season: some experiments were tried at Muzaffargarh and Hoshiarpur which showed that smoky fires under the infected trees are useful in driving away the insects.

12. *Melon fly*.—It was reported to destroy the melon crop near Jullundur. We recommended the plucking off and destruction of the first lot of infected fruits. Wherever this measure was carried out the crop improved.

13. Other minor work of spraying insect pests of crops has been carried out.

MADAN MOHAN LAL,

*Assistant Professor of Entomology,
Lyalpur.*

APPENDIX V.

Report of the Agricultural Engineer.

Introductory.—I assumed the duties of Agricultural Engineer on 13th February 1915 and have recently taken over the work of well boring.

Well boring.—Up till 31st March the sanctioned staff for this work remained the same as in previous years, *viz.*, 3 supervisors, 20 borers and 20 mates. Although sanction was obtained for an increase in this establishment from 1st April, I have not yet availed myself of this, and shall not do so until I have decided the direction in which an increase will prove most economically effective. During the year boring work has been carried on in 11 districts, a total of 237 wells having been bored; this is a decrease of 55 over last year. Six trial borings were made. An increase in water-supply was obtained in 141 of the wells, the remaining 96 being counted as failures; considering that only one system of boring and treating wells is in vogue at present it is surprising that the percentage of success, 59½ per cent., is so high, and is increasing. Apart from the fact that certain failures are due to the present system of treatment being unsuitable for many subsoils, there are numerous borings entered as failures simply because the well owners are unprepared to pay the cost of completing the work; many of these so-called failures could be made successful if the work is completed at Government expense and the cost recovered gradually from the owners as their income increases due to the benefits derived from the increased supply of water. It is hoped by altering the treatment system to meet various subsoil conditions that a supply will be obtained in many areas at present considered unsuitable for boring operations; unfortunately experiments in this direction have been seriously delayed on account of the difficulty in obtaining the necessary materials on account of the war.

During the year there has been a keen demand from zemindars for boring, many requests coming from districts in which the tahsildars reported that boring work was not required. Considerable delay has been occasioned by well owners not supplying the necessary labour immediately the borer is ready for it, and in the harvesting season boring work is practically at a stand-still until labour is supplied. An improvement in results may be obtained by making the supervisors and borers largely responsible for the preparation of their own boring programmes and by employing a permanent staff of labourers to work where the owners delay in supplying labour, owners being charged all expenses incurred. Small borings are highly appreciated by the small holding cultivator, they are inexpensive, and yield a sufficient supply to be worked by one or two bullocks. In each of the 141 successful borings carried out, the irrigated area has been considerably extended, and therefore Government benefits on account of increased revenue, while the advantage to the cultivator is very great, representing in some cases the difference between abject poverty and a life of comparative comfort. The system deserves every encouragement, and I hope in future to be able to report considerable extensions in this class of work.

Tube wells.—Under this heading I include schemes by which subsoil water is obtained from borings only by mechanical power, the supply ordinarily being six to twelve times that obtained by animal power from an excavated well. During the last three months of the year 22 enquiries for this class of irrigation plant have been dealt with, and it is hoped that several will be put down in this coming year. One application for a plant of this description has already been received, and the work will be carried out on the arrival of plant from England; it was ordered last December.

Boring plant.—For the large borings necessary for tube wells, special plant is required. Twelve inches tubes for this work were ordered from England in December last and so far have not arrived. Fifteen inches tubes are also required, and these were ordered in April; so it is hardly expected these latter will arrive in time to be much used in 1915-16. A heavy boring machine, power driven, and a light power driven machine are required: enquiries are being made from foreign firms for a suitable type to meet subsoil conditions in the Punjab.

Other irrigation schemes.—A detailed report was submitted in June of the possibilities of development in the Mianwali district. Since this report was written, two trial borings have been made in the district, which verify my supposition that a large area of the district is suitable for tube well projects. A considerable area of the district offers indications of "artesian" water, and I hope that funds will be forthcoming for exploiting this. A proposal was also made in my report for impounding reservoirs in the Salt Range for irrigation purposes; there is no doubt of the benefit to be derived by these, and I trust that funds to carry out at least one impounding scheme will be allotted, and that I will be instructed at an early date to prepare the project in detail. My report on the Mianwali district also draws attention to the existence of, and advisability of boring for mineral oil, the advantages of harnessing the 400 horse power running to waste in the Nammal stream, and an estimate for a domestic water-supply for Musa Khel, Mianwali, etc. These latter schemes hardly come within the scope of Agricultural Engineering, but they are closely allied with it.

A small scheme for irrigation of land at Singhpura in the Gurdaspur district has been drawn up, and this will prove a direct source of income to Government as well as being of great benefit to the cultivators of the district and illustrative of the possibilities of lift irrigation. I trust that the small sum required for this work will be allotted at an early date.

T. A. MILLER BROWNLIE,

Agricultural Engineer to Government, Punjab, Lyallpur.

APPENDIX A.

No.	Name of district.	EXISTING AND PROPOSED WELLS.		REMARKS.
		No. of bores.	Successful.	
1	Gurgaon and Delhi	55	45	} Rewari Circle
2	Karnal	12	7	
3	Ambala	13	6	
4	Hissar	1	1	
5	Ludhiana	39	23	} Ludhiana Circle.
6	Ferozepore	19	8	
7	Montgomery	16	4	
8	Jullundur	42	29	} Jullundur Circle.
9	Sialkot	22	12	
10	Mianwali	2	1	
11	Sargodha	3	1	
12	Gurdaspur	13	5	
Total		237	141	

Of the total number of bores sunk, including trial bores, the percentage of success amounts to 59½.

Among the many unsuccessful bores are included those in which work had to be stopped, as owners were unprepared to finance the work to a successful issue, and also many bores sunk in subsoil which required treatment different to that in practice at present in order to obtain success.

APPENDIX VI.

Report of the Professor of Agriculture on the Lyallpur Farm.

1. The rainfall for the year, Statement I, amounted to 21·05 inches as compared with 16·84 inches in the previous year and an average of 14·99 inches for the last five years, and of 15·32 inches for the last ten years. Frost set in earlier than usual, *i. e.*, on December 6th. A brief note on the effect of the season on the various crops is given below.

(1) *Cotton*.—The heavy rain in July stimulated vegetative growth and the crop in August looked flourishing, but was fruiting poorly. An unusual hailstorm on October 15th did local damage, whereas early frosts also did some harm. The yield was 9 annas as compared with the previous year.

(2) *Maize*.—Germination was poor and the young crop was flooded out in many parts of the colony, thus making sowing late. The hailstorm noted above did immense damage near Lyallpur and most of the farm maize and that grown by tenants was failure. Maize borer was very prevalent throughout the colony.

(3) *Toria*.—Suffered severely from hail and later from frost; yield was 8 annas as compared with 1913. The area was less than in previous years as zemindars were advised the price might be low: but owing to the failure of the Bengal til crop the demand was better than anticipated, and prices were only Re. 1 per maund lower than in previous years. The crop however was not a paying one, on account of the low yield.

(4) *Wheat*.—The area was 16 per cent. above normal in the colony and the crop was doing well up to the end of December when rust began to appear. It is very unusual to see rust so early. The crop recovered in February and March but grain was shrivelled in most places, much more so than I have seen it during the past six years. Yields were therefore lower than anticipated, but were about level with the previous year.

(5) *Sugarcane*.—Season was unfavourable. Borer was common early in the season. Hail and early frost also damaged the crop extensively.

In general, the season was thus, in spite of good rainfall, somewhat unsatisfactory; but it is gratifying to note that both cotton and wheat from farm seed did extremely well in the colony.

Experiments at the farm.—Sugarcane, maize and cotton manurial experiments.—For full details see report for 1911-12, since which year this experiment has been continuing. See Statements II, III, and IV.

Yields are low, but the addition of artificials has caused an increase of $4\frac{1}{2}$ maunds of gur valued at Rs. 18: whereas the artificial manures cost Rs. 66-8-0.

Some of the residue is available for maize and cotton: but generally speaking it appears to be uneconomical to add artificials to heavy dressings of farm yard manure for cane.

Maize—(Statement III).—Results inconclusive owing to failure of crop.

Cotton—(Statement IV).—Practically no effect as in previous years.

Manurial experiments with sugarcane, maize and cotton in the Kharif series and gram, wheat and toria in the rabi series.—See report for 1911-12 for details: statements V—XI.

Kharif series.—The object of this series is to secure information about the requirements of the soil with regard to plant food and its reaction in the field to artificial fertilizers. The quantities applied are therefore high and would not in any case be economical in practice. This is really an attempt to do by field tests what the chemist does in his laboratory. The results may give indications for future economic tests. It will serve no purpose therefore to detail the cost of manures in each case, although it is carefully recorded at the farm.

Sugarcane—(Statement V).—The increase in yields over unmanured plots is marked throughout. The farm yard manure plot has yielded less than other manured plots, though yields in all are low compared to past years. This result is largely attributed to the character of the season.

Maize—(Statement VI).—No useful deduction is possible, as owing to causes already noted the crop was a failure.

Cotton—(Statement VII).—Gypsum still continues to have a marked effect. Further practical trials of this manure against phosphates are contemplated as supplies of gypsum are available in the Salt Range.

Rabi series.—Toria—(Statement VIII).—For this crop there are signs that the land has already become too rich. The test will however be continued.

Gram—(Statement IX).—The yields are high and still show increases of from 2 to 3 maunds over unmanured portions. Non-nitrogenous manures suit gram best throughout and this is according to expectations, as this crop is itself a nitrogen fixer.

Wheat—(Statement X).—Yields are good, considering that rust was prevalent in all plots. The plot under lime manure yielded best with $20\frac{1}{2}$ maunds. The straw was coarse and the crop lodged in all cases. The plots show signs of over-richness, but it is proposed to continue the test for a few years more.

Toria in square 26—(Statement XI).—Yields low, but of interest as confirming last year's remarks as to the uniformity of the land for testing purposes especially the northern end. Hail severely damaged the southern end where the crop should have been best. Toria was poor everywhere in the colony.

Spacing experiments with 4 F. cotton—(Statement XII).—The results are as would be expected, and confirm observations made in the colony. The first three plots are in poor land as compared with the latter three. In these poor plots the usual distance of 3 feet seems to be most suitable even in a year of excessive vegetative growth as last year was. In the other three plots the wider distance of $4\frac{1}{2}$ feet between rows has given the best yield. All plots damaged by hail and frost.

Sugarcane variety experiments—(Statement XIII).—The Kahu variety has again shown its superiority at Lyallpur both over katha and dhaul. The latter cane does well at Gurdaspur but does not suit Lyallpur, except under optimum conditions. It has, therefore, been definitely discarded this year. Katha is a very thin local variety and is very hardy. It will be used as a standard in testing other canes. The yields of kahu and katha considering the season are good. Two new varieties will be tried next season.

Varietal tests with wheat—(Statement XIV).—The test was to compare Punjab types 17 and 11 and Pusa 12. The test was made on uniform land under a definite cropping rotation in square 26 under identical conditions with those of last year. One acre of each was grown after cotton and one acre of each after wheat. The results are as follows:—

After cotton.

						Mds.	Srs.
Punjab 11	...	...	...	...	...	21	12
Punjab 17	...	...	...	...	...	20	27
Pusa 12	...	...	...	...	...	20	5

After wheat.

Punjab 11	...	...	...	...	...	18	35
Punjab 17	...	...	...	...	...	17	37
Pusa 12	...	...	...	...	...	19	0

The average of two acres works out as follows:—

						Mds.	Srs.
Punjab 11	...	...	...	...	...	20	4
Punjab 17	...	...	...	...	...	19	12
Pusa 12	...	...	...	...	...	19	23

It will be seen that after cotton Punjab 11 is leading, followed by Punjab 17. After wheat, Pusa 12 leads with five seers over Punjab 11.

On the average of two acres Punjab 11 leads by $\frac{1}{2}$ maund per acre over Pusa 12 and $\frac{3}{4}$ maund over Punjab 17. Again in 11 acres with various tenants, where the test was made in a similar way, Pusa 12 gave a higher yield in 2 plots only, and on the average of 11 plots gave 13 maunds and 31 seers while Punjab 11 gave 15 maunds and 10 seers, or nearly $1\frac{1}{2}$ maunds per acre more.

Two tests were also made with Zemindars, *viz.*, in Chak 111 G. B. by M. Nizam Din and in Gangapur by Rai Sahib Sewak Ram.

In 111 G. B. the land was of moderate fertility and appeared fairly uniform judging from surrounding crops. The average yield for Punjab 11 was 14 maunds and 8 seers and for Pusa 12 it was 12 maunds and 20 seers, or 1 maund and 28 seers less per acre.

At Gangapur alternate acres were grown with either variety; a good deal of the land was rich, and thus not very uniform. With Rai Sahib Sewak Ram's tenants Punjab 11 was slightly better than Pusa 12, but in one plot in *khudkasht* (area cultivated by owner) the yield of Pusa 12, is 7 maunds higher than Punjab 11 in one *killa*. Punjab 11 lodged badly and this, in the opinion of the Rai Sahib, accounts for the great difference in yield. As a result of all these tests I am convinced that Punjab 11 is the best yielding wheat we have. Over 6,000 acres of it were grown from the department's seed by zemindars in the colony this year, and was very well reported on everywhere. The pros and cons of these two wheats may be stated thus:—

Pusa 12 is a strong strawed, early ripening, beardless wheat. It stands better than Punjab 11, though the latter as stated by Howard in his "Book on Wheats" is a strong strawed wheat also, and generally stands very well. Pusa 12 ripens early and thus can be harvested some days before Punjab 11 is ready. Being beardless it is attacked by birds, but in a big area this is not serious. Rats also show a preference for it, and some trouble was experienced in this and the previous season from this cause. Rust this year attacked the heads of Pusa 12 in the end of February. In other wheats rust was disappearing at that time. It tillers badly in comparison to local varieties. From a large number of observations taken this year I reckon Punjab 11 tillers 20 per cent. more, and Punjab 17 as much as 35 per cent. more, than Pusa 12. This fact being previously known, the seed rate used for Pusa 12 has been 4 or 5 seers more than for No. 11; thus, while for the latter 24 seers is ample in Lyallpur, the usual seed rate for Pusa 12 is 28 or 30 seers. The bhusa is slightly coarser, as might be expected. The grain of Pusa 12 is bolder and the crop looks well to the eye. But even with a premium of 2 annas a maund, assuming equal yields, an average crop of 14 maunds fetches Re. 1-12-0 more, which is not enough to equalise half a maund difference in yield per acre.

In the colony the wheats at present grown are 65 per cent. of Punjab 11 of 80 per cent. purity and 35 per cent. of Punjab 17 of 80 per cent. purity. I am of opinion that there may be a limited opening for Pusa 12 in those tracts where Punjab 17 is at present grown, or where a zemindar is anxious to have a portion of his crop early ripening; but further tests are necessary.

Punjab wheat type 11 and Punjab wheat type 17.—The average of 18 plots with tenants was 11 maunds and 6 seers for No. 11 and 10 maunds and 14 seers for Punjab 17. This result is notwithstanding the fact that one plot of No. 11, owing to kallar was very poor, having only given 4 maunds and 15 seers. Type 17 is of interest as it is common in the colony, being sometimes over 90 per cent. pure 'in zemindars' fields. It is reckoned as being a better quality wheat than No. 11 and is preferred for home consumption. It fetches practically no premium in the market and is thus generally not as profitable as No. 11. In some tracts it is being rapidly replaced by No. 11.

Desi versus Rajah plough.—This will be discussed when the results of experiments carried through a series of years are available.

Hydraulic experiments—(statement XV).—The module for measuring water was finally handed over by the Irrigation Department in June 1915, so it will now be possible to carry out these experiments with the accuracy and care necessary, if they are to be of value. With regard to the past season it may be noted that heavier waterings at less frequent intervals, provided the surface soil is stirred, may prove efficient.

The prevalence of kallar in this square affected results in plots 3 and 4.

Calcium Nitrate on wheat;—(Statement XVI).—This manure has been applied in these plots for six years in succession for wheat. All plots show increases, but two only show a profit, while the net result is a loss on the manure of Re. 1-8-0 per acre. This experiment is of scientific interest and will be continued.

Hot weather versus rain ploughing for wheat—(Statement XVII).—As in previous years there is practically no difference in outturn on the average. In the Punjab it is practically impossible to get at the land before the latter half of May and ordinary ploughing takes place as soon as rain comes, in this case at the end of June. This question was discussed by me in the Agricultural Journal of October 1913, and so far there seems to be no reason to alter the views then expressed. The experiment will be continued.

Other wheat variety tests.—Punjab No. 11 was tested in a number of plots against Punjab types 17, 12, 19 and 20. The superiority of No. 11 was evident throughout when the average yield per acre is calculated. A number of wheats (sub-varieties of Punjab types) were also grown for Economic Botanist, but were not tested for yields owing to lack of space and the greater importance of duplicating tests against other important types such as No. 17 and Pusa 12.

Cotton varieties.—

American varieties.—No. 4 F. continued to do well, and over 350 maunds of seeds were sold in Lyallpur in the spring of 1914.

Desi varieties.—Five new varieties were handed over by Economic Botanist. These varieties are types existing in ordinary desi as grown in the colony. Further work is in progress, as the number was incomplete last year. Useful results are expected from the work.

Rosea was used as standard as more seed of it was available, though yellow flowered Indicum would have been more suitable. The crop was damaged by hail.

Miscellaneous experiments—(Statement XVIII).—Sugar beet and Mangel Wurzel for fodder :—

These crops were sown at two different dates with a view to comparing their yields under favourable conditions and to indicate the best time for sowing. The crop of Mangels was heavy: this shows promise of becoming a very useful root crop. It will be noted that addition of ashes has not improved the yield in any of the plots. The relatively larger proportion of leaves to roots in sugar beet may be noted. It is finally settled that this crop will not pay as a fodder crop in the Punjab, and the outturn and quality of the roots is not such as to give any hope of their being of use for the production of beet sugar. Seed for 10 acres of Mangel Wurzel is available for the coming season's trials. The heaviest root weighed 26 lbs.

Feeding trials, cotton cake versus grain.—Four pairs of working cattle were selected and one from each pair received cake and the other grain. The trials extended over four months. All the animals maintained their condition fairly well and increased slightly in weight. The cost of the cake for 4 bullocks for 4 months was Rs. 46-8-0 and of grain at Rs. 3 a maund, Rs. 72. The saving is, therefore, Rs. 25-8-0.

Cotton cake for dairy cows.—A careful trial was made of this food as compared to gram for milking cows by the dairy research scholar B. Kartar Singh, and a note on the subject

has been sent for publication to the Indian dairy journal. It was shown that cotton cake can be economically used as a food for dairy cows. Cake can be bought in Lahore at Re. 1-10-0 a maund.

Siloing maize and jowar.—Three silos were made, two of which were filled with chari (jowar) and one with maize to test the feasibility of this method of storing fodder. A separate report will be submitted, but it may be noted here that the method is unsuitable generally for the Punjab and is of very limited application. The dryness of the climate makes it very difficult to store the fodder in the right condition. Jowar can be kept dry in stacks in very good condition, whereas maize is very seldom grown for fodder here.

Poultry.—Work is proceeding slowly along the lines indicated in last year's report. Only the produce of good layers are being kept and work is confined to desi breeds.

College Dairy.—The College dairy has been in full working order, though many buildings are still incomplete. The herd consists of 22 Montgomery cows of good quality and one bull, the latter kindly selected for us by Colonel Farmer, C. V. D. The average daily milk yield has been good, viz., 2·8 seers, for the period October 1st to June 30th. B. Kartar Singh L. Ag. worked as research student in the dairy from July to October 20th. A note on some of the work done has been sent for publication. This student has since been working at Ambala, Lahore and Poona military dairies, and recently at the civil dairy, Poona, where he is studying the conditions of milk supply and dairying in western India.

Pasture experiments.—An area of 20 acres has been laid down in pasture experiments. Two main lines of investigation are :—

- (1) Finding the most profitable grass for irrigated pasture, and
- (2) The most economical number of waterings for grass. Large areas in the colony are under *chiragah*, and it is hoped some information will be acquired as to the best treatment for such areas with a view to getting some return from the land.

Drills.—Some experiments are being conducted with country drills none of which at present give entirely satisfactory results. Experiments are being continued : some success has already been obtained in them. A note giving full details is ready for publication.

W. ROBERTS,
Professor of Agriculture.

XXX

Statement No. I.

SHOWING THE RAINFALL AT THE LYALLPUR AGRICULTURAL STATION DURING THE YEARS 1913-14 and 1914-15.

1					2		3	
Name of month.					Rainfall during 1914-15		Rainfall during 1913-14.	
June	...	...	...	...	1.66		2.15	
July	...	...	...	...	8.18		4.94	
August	...	...	...	...	3.95		5.37	
September	...	...	...	...	1.70		0.31	
October	...	...	...	...	2.33		...	
November	...	...	...	...	.07		...	
December	...	...	...	...	.17		0.54	
January	...	...	...	...	...		.01	
February	...	...	...	...	.32		0.62	
March	...	...	...	...	1.91		0.96	
April	...	...	...	...	.76		1.56	
May	...	...	...	...	...		0.33	
Total					21.05		16.84	

Statement No. II.

SHOWING THE RESULT OF SUGARCANE GROWN IN THE MANURIAL AND ROTATIONAL SERIES AT THE LYALLPUR AGRICULTURAL STATION IN KHARIF 1914.

No. of square.	No. of plot.	ABBA.		Name of variety.	Treatment.	WEIGHT OF GREEN TOPS.		WEIGHT OF CANE.		WEIGHT OF JUICE.		WEIGHT OF GUR.		WEIGHT OF GUR PER ACRE.		Percentage of green tops to cane.	Percentage of juice to cane.	Percentage of gur to juice.	Percentage of gur to cane.	REMARKS.
		Kanals.	Marlas.			Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.					
27 C.	1	4	...	Katha variety.	Farm yard manure at 15 tons per acre + crude nitre at 488.38 lbs. containing 65 lbs. nitrogen per acre.	115	5	125	1	64	35	10	22	21	4	92.08	51.6	16.26	8.43	Ploughing ... 4
	2	4	...		Farm yard manure at 15 tons per acre + calcium nitrate at 545.78 lbs. containing 65 lbs. nitrogen per acre.	118	15	105	12	50	28	8	30	17	20	112.4	48.1	17.2	8.3	Harrowing ... 10 Sohagaing ... 22 Hoeing and weeding ... 7 Watering ... 10
	3	4	...		Farm yard manure at 15 tons per acre.	105	18	96	34	46	7	8	0	16	0	108.7	47.6	17.3	8.2	Date of sowing 23rd-24th April 1914. Date of crushing commenced: 31st December 1914.
	4	4	...		Ditto.	102	20	101	29	48	14	9	2	18	4	101.007	47.5	18.7	8.8	Date of crushing finished: 6th January 1915.

Statement No. III.

SHOWING THE OUTTURN OF MAIZE GROWN IN THE MANURIAL AND ROTATIONAL SERIES IN KHARIF 1914,
 AREA — AT THE LYALLPUR AGRICULTURAL STATION.

No. of square.	No. of plot.	Name of variety.	Treatment.	AREA.		WEIGHT OF DRY STALKS.		WEIGHT OF DRY COBS.		WEIGHT OF GRAIN.		YIELD PER ACRE.		REMARKS.
				Kanals.	Marlas.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
27 C ₁	1	Red local maize.	Residue of green-manuring with Serji	4	0	7	15	0	39	0	30	1	20	Ploughing ... 6 Harrowing ... 16
	2		Ditto ...	4	0	11	3	1	33	1	14	2	28	Sohagaing ... 20 Hoeing and weeding ... 2
	3		Residue of green manuring with serji + calcium nitrate at 530.6 lbs. containing 65 lbs. nitrogen per acre.	4	0	9	4	2	4	1	23	3	6	Watering ... 2 Date of sowing 23rd August 1914.
	4		Residue of green manuring with Serji + potassium nitrate at 488.36 lbs. containing 65 lbs. nitrogen per acre.	4	0	8	25	1	3	0	31	1	22	Date of harvesting 7th December 1914.

N. B.—The crop suffered very badly from hail on the 15th of October and hence the yield was low.

Statement No. IV.

SHOWING THE RESULT OF RESIDUAL EFFECT OF MANURE ON FARM-SELECTED BROAD LEAF COTTON GROWN IN THE MANURIAL AND ROTATIONAL SERIES AT THE LYALLPUR AGRICULTURAL STATION IN KHARIF 1914.

No. of square.	No. of plot.	AREA.		Variety.	Treatment.	ACTUAL OUTTURN.		OUTTURN PER ACRE.		REMARKS.
		Kanals.	Marlas.			Maunds.	Seers.	Maunds.	Seers.	
27 C ₁	1	4	0	Farm selected broad leaf cotton.	Residue of castor cake at 10 ½ cwts. per acre.	2	29	5	18	Ploughing ... 8 Harrowing ... 11
	2	4	0		Ditto ditto	3	37	7	34	Sohagaing ... 10 Hoeing and weeding ... 6
	3	4	0		Residue of castor cake at 10½ cwts. per acre + calcium nitrate at 530.6 lbs. containing 65 lbs. nitrogen per acre.	3	32	7	24	Watering ... 2 Date of sowing 31st April 1914.
	4	4	0		Residue of castor-cake at 10½ cwts. per acre + potassium nitrate at 488.36 lbs. containing 65 lbs. nitrogen per acre.	2	25	5	10	Picking began on 19th September 1914. Picking finished on 11th December 1914.

STATEMENT No. V.

SHOWING THE OUTTURN OF SUGARCANE GROWN IN THE MANURIAL BLOCK AREA D, STANDARD K, SQUARE 27, AT THE LYALLPUR AGRICULTURAL STATION IN KHARIF 1914.

No. of square.	No. of plot.	Name of variety.	Treatment.	Area in acres.	WEIGHT OF GREEN TOPS.		WEIGHT OF CANE.		WEIGHT OF JUICE.		WEIGHT OF GUR.		YIELD OF GUR PER ACRE.		Percentage of green tops to cane.	Percentage of juice to cane.	Percentage of gur to juice.	Percentage of gur to cane.	REMARKS.
					Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.					
27	23	Katha variety.	Unmanured ...	133/8	2	28	2	2	1	1	0	6	5	14	131.7	50.0	16.1	7.31	Ploughing ... 4
	24		Bone meal at 2 cwts. 80 lbs. + lime at 5 cwts. per acre.	1/4	31	10	32	6	16	32	3	0	15	0	97.2	52.2	17.8	9.3	Harrowing ... 10
	25		Unmanured ...	133/8	6	15	7	8	3	24	0	23	10	10	88.5	50.0	16.3	7.9	Sohagaing ... 18
	26		Lime at 5 cwts. per acre + ammonium sulphate at 2 cwts. 106.22 lbs. per acre.	1/4	37	31	42	19	22	21	3	28	17	20	88.8	53.03	16.4	8.7	Hoeing and weeding ... 11
	27		Unmanured ...	133/8	6	19	0	15	3	10	0	24	19	28	101.5	50.9	18.4	9.4	Watering ... 11
	28		Farm yard manure at 4 tons per acre.	1/4	22	16	28	26	13	0	2	2	10	10	78.1	45.3	15.7	7.1	Date of sowing 30th April 1914 to 1st May 1914.
	29		Unmanured ...	133/8	6	10	5	33	2	30	0	19	8	19	109.9	47.2	17.6	8.1	Crushing began on 14th December 1914.
	30		Bone meal at 2 cwts. 80 lbs. + lime at 5 cwts. + ammonium sulphate at 2 cwts. 106.22 lbs. per acre.	1/4	37	0	35	11	18	5	2	38	14	30	104.8	51.3	16.2	8.3	Crushing finished on 31st December 1914.
	31		Unmanured ...	133/8	5	3	5	2	2	20	0	15	6	28	100.4	48.4	15.5	7.42	
	32		Calcium nitrate at 5 cwts. 9.968 lbs. + ammonium sulphate at 2 cwts. 106.22 lbs. + superphosphate at 231 lbs. per acre.	1/4	40	25	36	5	18	30	2	38	14	30	112.4	52.2	15.73	8.1	
	33		Unmanured ...	133/8	3	29	3	29	2	4	0	12	5	14	93.7	52.8	14.28	7.54	

STATEMENT No. VI.

SHOWING THE OUTTURN OF MAIZE GROWN AT THE MANURIAL BLOCK STANDARD D, SQUARE 27, AT THE LYALLPUR AGRICULTURAL STATION.

No. of square.	No. of plot.	Name of variety.	Treatment.	Area in acres.	WEIGHT OF DRY STALKS.			WEIGHT OF FRESH COBS.			WEIGHT OF DRY COBS.			WEIGHT OF GRAIN.			YIELD PER ACRE.			REMARKS.
					Maunds.	Seers.	Chhataks.	Maunds.	Seers.	Chhataks.	Maunds.	Seers.	Chhataks.	Maunds.	Seers.	Chhataks.	Maunds.	Seers.	Chhataks.	
27	1	Red local maize.	Unmanured ...	133/8	0	15	0	0	0	9	0	0	6	0	0	3	0	6	11	Ploughing ... 6
	2		Bone meal at 2 cwts. 80 lbs. per acre in place of superphosphate.	1/4	2	35	0	0	11	14	0	9	6	0	6	4	0	31	4	Harrowing ... 12
	3		Unmanured ...	133/8	0	30	0	0	1	5	0	0	13	0	0	7 1/2	0	8	5	Sohagaing ... 17
	4		Bone meal at 2 cwts. 80 lbs. per acre.	1/4	2	32	0	0	13	3	0	10	10	0	7	8	0	37	8	Hoeing and weeding ... 2
	5		Unmanured ...	133/8	0	25	0	0	3	5	0	2	1	0	1	4	0	22	5	Watering ... 2
	6		Farm yard manure at 4 tons per acre.	1/4	2	35	0	0	15	15	0	13	6	0	9	12	1	8	12	
	7		Unmanured ...	133/8	0	25	0	0	3	...	0	1	14	0	1	3	0	21	2	Sown on 15th August 1914
	8		Basic slag at 8 maunds per acre.	1/4	3	16	0	0	13	15	0	9	13	0	7	4	0	36	4	re-sown on 23rd August 1914.
	9		Unmanured ...	133/8	0	26	0	0	1	2	0	0	15	0	0	9 1/2	0	10	9	
	10		Lime at 5 cwts. per acre	1/4	3	20	0	0	13	4	0	9	10	0	7	8	0	27	8	Harvested on 3rd December 1914.
	11		Unmanured ...	133/8	0	12	0	0	1	5	0	0	15	0	0	10	0	22	4	

N.B.—Yields were very poor on account of damage by hail.

STATEMENT No. VII.

SHOWING THE OUTTURN OF COTTON GROWN IN THE MANURIAL BLOCK STANDARD KHARIF AREA D,
SQUARE 27, AT THE LYALLPUR AGRICULTURAL STATION.

No. of square.	No. of plot.	Name of variety.	Treatment.	Area in acres.	ACTUAL OUTTURN.		OUTTURN PER ACRE.		REMARKS.
					Maunds.	Seers.	Maunds.	Seers.	
27	12	Farm selected broad leaf cotton.	Unmanured ...	1 $\frac{3}{4}$	0	6	5	14	Ploughing ... 3
	13		Calcium cyanamide at 3 cwts. and 60.7 lbs. per acre.	$\frac{1}{2}$	1	12	6	20	Harrowing ... 10
	14		Unmanured ...	2 $\frac{3}{4}$	0	11	4	37	Sohagaing ... 6
	15		Calcium nitrate at 5 cwts. and 9.968 lbs. per acre.	$\frac{1}{2}$	1	9	6	5	Hoeing and weeding ... 5
	16		Unmanured ...	2 $\frac{3}{4}$	0	14	6	9	Waterings ... 4
	17		Farm yard manure at 4 tons per acre	$\frac{1}{2}$	1	15	6	35	Date of sowing 22nd April 1914.
	18		Unmanured ...	2 $\frac{3}{4}$	0	10	6	35	Picking started on 17th September 1914.
	19		Ammonium sulphate at 2 cwts. and 109.76 lbs. per acre.	$\frac{1}{2}$	1	21	7	25	Picking finished on 11th December 1914.
	20		Unmanured ...	2 $\frac{3}{4}$	0	13	5	32	
	21		Gypsum at 5 cwts. per acre	$\frac{1}{2}$	1	18	7	10	
	22		Unmanured ...	1 $\frac{3}{4}$	0	5	4	18	

STATEMENT No. VIII.

SHOWING THE OUTTURN OF TORIA GROWN IN THE MANURIAL BLOCK AREA D, SQUARE 27, AT THE
LYALLPUR AGRICULTURAL STATION.

No. of square.	No. of plot.	Name of crop.	Treatment.	Area in acres.	GRAIN.		STRAW.		YIELD OF GRAIN PER ACRE.		REMARKS.
					Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
27	12	Toris.	Unmanured ...	1 $\frac{3}{4}$	0	5	0	13	4	18	Ploughing ... 3
	13		Calcium cyanamide at 3 cwts. 60.7 lbs. per acre.	$\frac{1}{2}$	1	13	3	30	6	25	Harrowing ... 8
	14		Unmanured ...	2 $\frac{3}{4}$	0	12	0	29	5	14	Sohagaing ... 3
	15		Calcium nitrate at 4 cwts. and 110.6 lbs. per acre.	$\frac{1}{2}$	1	12	3	2	6	20	Hoeing and weeding Nil
	16		Unmanured ...	2 $\frac{3}{4}$	0	13	0	30	5	31	Watering ... 3
	17		Farm yard manure at 4 tons per acre.	$\frac{1}{2}$	1	21	3	10	7	25	Date of sowing 2nd September 1914.
	18		Unmanured ...	2 $\frac{3}{4}$	0	13	0	30	8	37	Date of harvesting. 28th December 1914.
	19		Ammonium sulphate at 2 cwts. and 109.76 lbs. per acre.	$\frac{1}{2}$	1	19	4	4	7	15	
	20		Unmanured ...	2 $\frac{3}{4}$	0	12	0	26	5	14	
	21		Gypsum at 5 cwts. per acre	2 $\frac{3}{4}$	1	...	2	23	5	0	
	22		Unmanured ...	1 $\frac{3}{4}$	0	5	0	12	4	18	

Statement No. IX.

SHOWING THE OUTTURN OF GRAM GROWN IN THE 2ND MANURIAL SERIES AT THE LYALLPUR AGRICULTURAL STATION.

No. of square.	No. of plot.	Name of crop.	Treatment.	Area in acres.	ACTUAL OUTTURN.				OUTTURN PER ACRE.				REMARKS.
					Grain.		Bhusa.		Grain.		Bhusa.		
					Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
D 27— R	23	Local gram.	Unmanured ...	$\frac{37}{1330}$	0	8	0	20	7	5	17	33	Ploughing ... 5
	24		Bonemeal at 304 lbs. and lime at 560 lbs. per acre.	$\frac{1}{5}$	3	38	4	0	19	30	20	0	Harrowing ... 18
	25		Unmanured ...	$\frac{37}{600}$	0	36	1	10	16	2	22	12	Sohagaing ... 12
	26		Lime at 560 lbs. and ammonium sulphate at 340 lbs. per acre.	$\frac{1}{5}$	3	27	4	21	18	15	22	25	
	27		Unmanured ...	$\frac{37}{600}$	0	35	1	12	15	36	23	7	Hoeing (Lever Harrow and Khurpa) ... 5
	28		Farm yard manure at 4 tons per acre.	$\frac{1}{5}$	3	23	4	0	17	35	20	0	
	29		Unmanured ...	$\frac{37}{600}$	0	35	2	0	15	24	35	27	Watering ... 2
	30		Bonemeal at 304 lbs. and lime at 560 lbs. and ammonium sulphate at 340 lbs. per acre.	$\frac{1}{5}$	3	20	4	25	17	20	23	5	
	31		Unmanured ...	$\frac{37}{600}$	0	27	0	39	12	2	17	15	Date of sowing 1st October 1914.
	32		Superphosphate at 231 lbs. per acre and calcium nitrate at 558 lbs. and ammonium sulphate at 340 lbs. per acre.	$\frac{1}{5}$	3	10	3	30	16	10	18	30	
	33		Unmanured.	$\frac{37}{600}$	0	29	1	4	12	37	19	25	Date of harvesting 9th April to 20th April 1915.

Statement No. X.

SHOWING THE OUTTURN OF WHEAT GROWN IN THE 2ND MANURIAL SERIES AT THE LYALLPUR AGRICULTURAL STATION IN RABI 1914-15.

No. of square.	No. of plot.	Name of crop.	Treatment.	Area in acres.	ACTUAL OUTTURN.				OUTTURN PER ACRE.				REMARKS.
					Grain.		Bhusa.		Grain.		Bhusa.		
					Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
D 27— R	1	Wheat type IX.	Unmanured ...	$\frac{133}{1330}$	0	10	1	27	8	36	59	9	Germination good; growth uniform; badly lodged and badly attacked by rust.
	2		Superphosphate at 231 lbs. per acre.	$\frac{1}{5}$	2	11	16	11	11	15	81	15	Germination good; growth luxuriant; attacked by rust and rats; badly lodged after rain.
	3		Unmanured ...	$\frac{37}{600}$	0	32	5	25	14	10	100	14	Germination good; growth uniform; badly lodged before rain; rust present.
	4		Bonemeal at 304 lbs. per acre.	$\frac{1}{5}$	3	7	20	23	15	35	102	35	Germination good; growth uniform; rust present; badly lodged after rain.
	5		Unmanured ...	$\frac{37}{600}$	0	33	5	37	14	28	105	28	Germination good; growth regular; rust present; badly lodged after rain.
	6		Farm yard manure at 4 tons per acre.	$\frac{1}{5}$	3	20	20	1	17	20	100	5	Germination good; growth uniform; rust present; 50 per cent. lodged before rain and the rest lodged after rain.
	7		Unmanured ...	$\frac{37}{600}$	0	34	5	1	15	6	89	25	Germination good; growth regular; rust present; badly lodged after rain.
	8		Basic slag at 656 lbs. per acre.	$\frac{1}{5}$	3	21	21	6	17	25	105	30	Germination good; growth uniform; rust present; lodged badly; irregular in ripening.
	9		Unmanured ...	$\frac{37}{600}$	0	37	5	14	16	20	95	17	Germination good; growth regular; rust present; lodged badly; irregular in ripening.
	10		Lime at 560 lbs. per acre.	$\frac{1}{5}$	4	5	21	23	20	25	107	35	Germination good; growth uniform; rust present; badly lodged; irregular in ripening.
	11		Unmanured ...	$\frac{37}{1330}$	0	16	1	36	14	11	67	31	Germination good; growth regular; rust present; 90 per cent. lodging.

Ploughing ... 4
Harrowing ... 10
Hoeing (chain harrow) ... 2

Sohagaing ... 4
Watering ... 4

Date of sowing 25th October 1914.

Date of harvesting 22nd April to 24th April 1915.

NOTE.—Rust was bad in March in all the manurial plots, but afterwards it became equal in all the plots.

Statement No. XI.

SHOWING THE OUTTURN OF TORIA AND BHUSA GROWN IN SQUARE 26 AT THE LYALLPUR AGRICULTURAL STATION.

No. of square.	Name of plot.	Name of crop.	Previous crop.	Area in acres.	STRAW.		GRAIN.		YIELD OF GRAIN PER ACRE.		REMARKS.
					Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
26	A ₂ 1 A	Toria	Wheat	$\frac{1}{2}$	7	1	3	0	6	0	Ploughing ... 3
											Harrowing ... 7
	A ₂ 2 A	Do.	Do.	$\frac{1}{2}$	7	16	2	36	5	32	Sokagaing ... 3
											Watering ... 3
	A ₂ 3 A	Do.	Do.	$\frac{1}{2}$	8	21	3	22	7	4	Date of sowing 1st September 1914.
	A ₂ 1 B	Do.	Do.	$\frac{1}{2}$	4	30	1	31	3	22	Date of harvesting 11th December to 20th December 1914.
	A ₂ 2 B	Do.	Do.	$\frac{1}{2}$	6	37	2	22	5	4	
	A ₂ 3 B	Do.	Do.	$\frac{1}{2}$	7	6	3	6	6	12	

Statement No. XII.

SPACING EXPERIMENT WITH 4 F COTTON IN SQUARE 26 AT THE AGRICULTURAL STATION, LYALLPUR.

No. of square.	No. of plot.	Name of variety.	Previous crop.	Area in acres.	ACTUAL OUTTURN.		OUTTURN PER ACRE.		REMARKS.
					Maunds.	Seers.	Maunds.	Seers.	
26	A ₂ 1 A	Cotton 4 F	Toria	$\frac{1}{2}$	2	12	4	24	$\frac{2}{3}$ rds of the usual distance, i.e. 2 feet.
	A ₂ 2 A	Ditto	Do.	$\frac{1}{2}$	2	26	5	12	Usual distance, i.e., 3 feet.
	A ₂ 3 A	Ditto	Do.	$\frac{1}{2}$	2	14	4	28	$1\frac{1}{2}$ times the usual distance, i.e., $4\frac{1}{2}$ feet.
	A ₂ 1 B	Ditto	Do.	$\frac{1}{2}$	1	39	3	38	$\frac{2}{3}$ rds of the usual distance, i.e., 2 feet.
	A ₂ 2 B	Ditto	Do.	$\frac{1}{2}$	2	7	4	14	Usual distance, i.e., 3 feet.
	A ₂ 3 B	Ditto	Do.	$\frac{1}{2}$	3	8	6	16	$1\frac{1}{2}$ times the usual distance, i.e., $4\frac{1}{2}$ feet.
	Ploughing	...	...	3	Hoing and weeding		...	...	9
	Harrowing	...	...	11	Watering		...	...	5
	Sokagaing	...	...	19			...	...	

Date of sowing 18th April 1914.
Date of picking commenced on 5th October 1914.
Date of picking finished on 4th January 1915.

Statement No. XIII.

SHOWING THE RESULTS OF VARIETY EXPERIMENTS WITH SUGARCANE AT THE LYALLPUR AGRICULTURAL STATION,—1914-15.

No. of square and killa.	Area.		Variety.	Treatment.	WEIGHT OF TOPS.		WEIGHT OF CANES.		WEIGHT OF JUICE.		WEIGHT OF GUR.		OUTPUT OF GUR PER ACRE.		Percentage of green tops to canes.	Percentage of juice to canes.	Percentage of gur to juice.	Percentage of gur to canes.	REMARKS.
	Kanals.	Marlas.			Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.					
1	5		Kahu	...	37	13	56	26	34	36	5	...	32	...	63.2	61.6	14.3	8.8	
1	18		Katha	...	54	2	79	18	42	3	7	9	30	19	78.07	54.25	17.2	9.1	
2	...		Kahu	...	67	11	79	23	45	8	6	25	26	20	84.4	56.7	14.6	6.3	Ploughing ... 1 Harrowing ... 6 Sohagaing ... 5 Hoing ... 3 Watering ... 8 Date of sowing 11th, 12th April 1914. Date of harvesting 26th November 1914 to 13th December 1914.
2	...		Katha	...	49	14	58	21	29	13	4	31	19	4	87.2	51.9	16.2	8.4	
2	...		Dhauhu	...	32	4	13	30	6	20	1	...	4	...	133.4	47.2	15.4	7.2	
2	...		Katha	...	69	27	57	6	28	6	4	24	18	16	121.9	49.2	16.5	8.05	
1	18		Dhauhu	...	63	5	45	1	18	37	2	34	12	...	140.2	42.03	15.66	6.0	Ploughing ... 2 Harrowing ... 4 Sohagaing ... 9 Hoing ... 3 Watering ... 9 Date of sowing 20th April 1914. Date of harvesting 25th January to 30th January 1915.
2	...		Katha	...	66	17	50	1	23	30	3	38	17	32	132.4	47.4	16.6	7.8	

STATEMENT XIV.

SHOWING THE COMPARATIVE TEST OF WHEAT TYPES 11, 17 AND PUSA 12 GROWN AT THE AGRICULTURAL STATION, LYALLPUR, RABI 1914-15.

No. of square	No. of plot.	AREA.		Name of type.	ACTUAL OUTTURN.				OUTTURN PER ACRE.				Previous crop.	REMARKS.
		Kanal.	Grain.		Bhusa.		Grain.		Bhusa.					
			Maunds.		Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.			
26	A -1 a	4	Pusa 12 ...	9	13	30	37	18	26	61	34	Cotton	...	Germination good; growth uniform; rust present; early; crop standing; attacked by rats; not well tillered.
	A -1 b	4	Ditto ...	10	32	35	26	21	24	71	12	Do.	...	
	A 1	4	Punjab 11 ...	9	33	30	25	19	26	61	10	Do.	...	Germination good; growth uniform; very well tillered; rust present; cent. per cent. lodged.
	A 1 2 a	4	Ditto ...	11	19	38	14	22	38	76	28	Do.	...	
	A 1 3 a	4	Punjab 17 ...	8	38	34	26	17	36	69	12	Do.	...	Germination good; growth uniform; tillering well; rust present; cent. per cent. lodged.
	A 1 3 b	4	Ditto ...	11	29	41	20	23	18	83	0	Do.	...	
	A 4 1 a	4	Pusa 12 ...	8	8	19	28	16	16	39	16	Wheat	...	Germination good; rust present; tillering not good; early crop, attacked by birds and rats.
	A 4 1 b	4	Ditto ...	10	32	23	15	21	24	46	30	Do.	...	
	A 4 2 a	4	Punjab 11 ...	8	37	20	12	17	34	40	24	Do.	...	Germination good; crop uniform; rust present; tillering very good; 12½ per cent. lodged.
	A 4 2 b	4	Ditto ...	9	38	21	12	19	36	42	24	Do.	...	
	A 4 3 a	4	Punjab 17 ...	8	0	18	11	16	0	36	22	Do.	...	Germination good; growth uniform; rust present; tillering very fair; 15 per cent. lodged; attacked by birds.
	A 4 3 b	4	Ditto ...	9	37	25	5	19	34	50	10	Do.	...	

	Area A-1		Area A-4	
Ploughing ...	...	7	6	
Harrowing ...	...	26	11	
Sohagaing ...	...	9	7	
Hoeing and weeding ...	...	5	5	
Watering ...	...	4	3	
Date of sowing ...	...	21st October 1914	23rd October 1914.	
Date of harvesting ...	...	16th April to 22nd April 1915	10th April to 24th April 1915.	

STATEMENT XV.

STATEMENT SHOWING THE RESULT OF HYDRAULIC EXPERIMENTS ON WHEAT GROWN IN SQUARE 10, BLOCK B, AT THE LYALLPUR AGRICULTURAL STATION IN RABI 1914-15.

No. of square and kills.	No. of sub-plot.	Treatment.	Area.		ACTUAL OUTPUT.				OUTPUT PER ACRE.				REMARKS.	
			Mahals.	Mahals.	Grain.		Bhusa.		Grain.		Bhusa.			
					Mounds.	Seers.	Mounds.	Seers.	Mounds.	Seers.	Mounds.	Seers.		
10 B ₁	1	2 kharis, ordinary cultivation, no harrowing, 4 waterings	2	0	3	6	7	30	12	24	31	0	Ploughing	6
	2	2 kharis, ordinary cultivation, deep harrowing, 3 waterings	2	0	3	11	7	10	13	4	29	0	Harrowing	3
	3	2 kharis, ordinary cultivation, no harrowing, 4 waterings	2	0	4	2	6	23	16	8	26	12	Sohagaing	6
	4	2 kharis, ordinary cultivation, deep harrowing and 3 heavier waterings	2	0	3	26	6	13	14	24	25	12	Hoeing and weeding	6 only in those where required in 2, 3, 2' and 4'.
10 B ₂	1 ¹	2 kharis, ordinary cultivation, no harrowing, 4 waterings	2	0	3	25	7	29	14	20	30	36	Waterings as in scheme.	
	2 ¹	2 kharis, ordinary cultivation, deep harrowing, 3 waterings	2	0	3	25	7	7	14	20	28	28	Date of sowing 30th October 1914.	
	3 ¹	2 kharis, ordinary cultivation, no harrowing, 4 waterings	2	0	3	1	8	28	12	4	34	32	Date of harvesting 24th April 1915.	
	4 ¹	2 kharis, ordinary cultivation, deep harrowing, 3 heavier waterings	2	0	2	17	5	19	9	23	21	36		
10 C ₁	1	Ordinary cultivation with 16 kharis per acre	2	0	3	10	6	29	13	0	26	36	Ploughing	6
	2	Ordinary cultivation with 8 kharis per acre	2	0	2	39	6	38	11	36	27	32	Harrowing	3
	3	Ordinary cultivation with 4 kharis per acre	2	0	3	28	6	15	14	32	25	20	Sohagaing	6
	4	Ordinary cultivation with 8 kharis per acre	2	0	2	39	6	5	11	36	24	20	Hoeing and weeding	6
10 C ₂	1 ¹	Ordinary cultivation with 16 kharis per acre	2	0	3	30	7	2	15	0	28	8	Watering	3
	2 ¹	Ordinary cultivation with 8 kharis per acre	2	0	3	36	6	28	15	24	26	32	Date of sowing 30th October 1914.	
	3 ¹	Ordinary cultivation with 4 kharis per acre	2	0	3	31	9	21	15	4	38	4	Date of harvesting 24th—26th April 1915.	
	4 ¹	Ordinary cultivation with 8 kharis per acre	2	0	3	8	9	38	12	32	39	32		

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STATEMENT XVI.

SHOWING THE RESULT OF CALCIUM NITRATE ON WHEAT GROWN AT THE LYALPUR AGRICULTURAL STATION SQUARE 7 IN RAM 1914-15.

No. of square and hills.	No. of plot.	MANURED.				No. of square and hills.	No. of the plot.	UNMANURED.				INCREASE PER ACRE.				INCREASE IN VALUE.		Deficit.	REMARKS.
		Quantity of calcium nitrate per acre.		AVERAGE OUTTURN PER ACRE.				AVERAGE OUTTURN PER ACRE.		AVERAGE OUTTURN PER ACRE.		AVERAGE OUTTURN PER ACRE.		Grain at Rs. 3-12-0 per maund.	Bhusa at Rs. 0-5-0 per maund.				
				Grain.	Bhusa.											Grain.	Bhusa.		
7 8	11	168 lbs.	13	36	81	8	2	7	18	20	6	36	28	Rs. A. P.	20 7 9	Rs. A. P.	...	Ploughing	... 4
7 8	4	168 lbs.	16	0	36	12	3	13	35	12	2	28	1	Rs. A. P.	20 7 9	10 0 9	...	Harrowing	... 4
7 9	2	112 lbs.	12	28	30	4	1	11	24	24	0	36	20	Rs. A. P.	13 10 6	8 9 0	...	Sodlagging	... 6
7 9	3	112 lbs.	6	36	24	7	4	11	34	4	4	8	2	Rs. A. P.	13 10 6	...	...	Hoeing and weeding	... 5
														Total 16 8 6				Date of sowing 28th October 1914.	
														0 12 6				Date of harvesting 26-27th April 1915.	
														15 12 0					
														8 6 0					
														10 2 0					
														25 14 0					
														3 15 6					
														29 13 6					
														10 7 0					
														0 5 0					
														5 1 6					

STATEMENT No. XVII.

SHOWING HOT WEATHER CULTIVATION *VERSUS* RAIN PLOUGHING WITH TENANTS AT LYALLPUR AGRICULTURAL STATION.

HOT WEATHER PLOUGHING.

No. of square.	No. of plot.	Type of wheat.	AREA.		ACTUAL OUTTURN.				OUTTURN PER ACRE.				REMARKS.
			Kanals.	Marias.	Grain.		Bhusa.		Grain.		Bhusa.		
					Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
6	7	11	9	7	14	20	35	7	12	16	30	9	Ploughed on 14th May 1914.
6	9	11	9	2	12	20	37	22	10	39	33	0	Ditto.
6	11	11	8	...	13	0	26	21	13	0	26	21	Ditto.
6	13	11	8	13	12	32	28	17	11	33	26	11	Ditto.
					52	32							

Ploughing ... 4
 Harrowing ... 4
 Watering ... 3
 Harrowing with chain harrow and lever harrow ... 3
 Date of sowing 3rd November 1914 to 8th November 1914.
 Date of harvesting 22nd April 1915 to 23rd April 1915.

RAIN PLOUGHING.

No. of square.	No. of plot.	Type of wheat.	AREA.		ACTUAL OUTTURN.				OUTTURN PER ACRE.				REMARKS.
			Kanals.	Marias.	Grain.		Bhusa.		Grain.		Bhusa.		
					Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
6	8	11	8	18	12	20	28	38	11	9	26	...	Ploughed on 30th June 1914.
6	10	11	8	...	9	0	18	14	9	0	36	28	Ploughed on 1st July 1914.
6	12	11	8	18	15	20	30	...	13	37	26	34	Ploughed on 30th June 1914.
6	14	11	9	11	15	4	30	23	12	26	25	24	Ploughed on 1st July 1914.
					52	4							

Ploughing ... 4
 Harrowing ... 4
 Young wheats harrowed with chain and lever harrow ... 3
 Watering ... 3
 Date of sowing 3rd November 1914 to 8th November 1914.
 Date of harvesting 22nd April 1915 to 23rd April 1915.

STATEMENT No. XVIII.

STATEMENT SHOWING THE OUTTURN OF MANGEL WURZEL AND SUGAR-BEET GROWN IN AREA "D" SQUARE 26, 1914-15.

No. of plot.	Area in acres.	Date of sowing.	Crop sown.	Treatment.	ACTUAL OUTTURN.				OUTTURN PER ACRE.			
					Roots.		Leaves.		Roots.		Leaves.	
					Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.
I	$\frac{412}{5445}$	22nd September 1914	Sugar-beet	Farm-yard manure at 15 tons per acre	18	38	10	0	250	13	132	19
II	"	Ditto	Ditto	Farm-yard manure at 15 tons + 500 maunds of ashes per acre.	17	11	5	26	228	21	74	31
III	"	Ditto	Mangel Wurzel	Ditto	52	5	2	32	689	6	37	2
IV	"	Ditto	Ditto	Farm-yard manure at 15 tons per acre	49	7	2	39	650	6	39	12
V	"	6th October 1914	Sugar-beet	Ditto	48	27	11	13	247	2	149	35
VI	"	Ditto	Ditto	Farm-yard manure at 15 tons + 500 maunds of ashes per acre.	17	10	12	29	228	1	168	10
VII	"	Ditto	Mangel Wurzel	Farm-yard manure at 15 tons per acre	63	22	6	25	840	5	87	27
VIII	"	Ditto	Ditto	Farm-yard manure at 15 tons + 500 maunds of ashes per acre.	53	0	4	30	700	30	62	34

APPENDIX VII.

Report of the Officiating Deputy Director of Agriculture on the
Gurdaspur Farm.

1. *Introductory.*—I was in charge of the farm till 14th October 1914, when Mr. Southern returned from leave. He joined the Indian Army Reserve of Officers and was again relieved by me on the 11th March 1915.

2. *Season and its effects upon the crops.*—The rainfall during the year amounted to 58.92 inches (*vide* Statement No. 1), as compared with 27.6 inches in the last year and with 34.9 inches, the average rainfall of the district. July was very wet: the rainfall during this month came almost to the year's average of the district, being 31.99 inches.

The season was favourable for sugarcane till the end of July, but subsequent rains and windstorms brought down the crop very badly: and bad weather delayed cane crushing much. Maize was much damaged: mash did fairly well, but suffered much at harvest time. The rabi season was wet, there being 11.58 inches of rain from November to March against 5.88 inches in the previous year, and 6.09 inches in the year before that. Gram was totally destroyed. The rains, however, were opportune for wheat and promised an unprecedented wheat harvest. But rains and winds in March and April affected the crop much. There being abundance of moisture in the soil, the roots had not to go down deep for water and food. They were shallow and the root system poor and badly developed; hence the plants easily gave way to winds and were dried up by the first hot breezes. The grain consequently remained undeveloped and became shrivelled, giving a very poor outturn.

The results of this year's experiments cannot, therefore, be looked upon as very reliable. It was an abnormal year. High lying, poor, uncultivated, untilled and double cropped lands in which the roots had to go deeper in search of water and food naturally fared better: cultivation and manure could produce no effect, and give no results in a year like this.

The season was very favourable for rust, which was bad on all wheats except Pusa 4, which was attacked by bunt. Smut was bad on the late tillers of the katha type of canes.

3. *Chahi area.*—The area, rotations and the objects of the experiments have been explained in former reports.

Kharif—Sugarcane—Statement No. 2.—Twenty-eight varieties only, which had done well both in the chemical laboratory and the field, were grown this year to test their comparative yield. The rest have been discarded as failures. Besides these 28, four new varieties were received from the United Provinces. Out of the 28 varieties, 12 have now been retained as they did well in the field, and seven more including the 4 from the United Provinces have been kept, as they gave good results in the laboratory.

Germination in some varieties was spoiled by the rains in early April, but the crop on the whole was an excellent one, and as it was very heavy, it could not withstand the rains and windstorms after July. The crop generally lodged except such varieties as were thick and short. The crop suffered a good deal through this lodging and repeated raising of the canes.

Frost was not severe and no apparent damage was done. Red-rot appeared in kahu types: one promising cane was totally killed. The attack on others was not so severe. A single line of Dhaulu cane streaked and unstreaked was planted and it was noticed that towards the end of the harvest there were only three stools in the streakless line, which were true to type. The others were streaked. The experiment is being repeated.

Local Dhaulu was planted in plots crossdrained, and this method was tested against the ordinary method. The results do not justify the expense and trouble of crossdraining the crop. The outturn of gur from the crossdrained plots was 31 maunds and 7 seers per acre against 32 maunds and 12 seers per acre obtained from other plots planted in the usual way.

Experiments with farm yard manure, a heavy dressing of 540 maunds per acre gave no results, owing to the heavy rains.

4. *October sown sugarcane.*—Five varieties which had hitherto resisted frost well, were planted in October 1913, to see if the planting season could be changed with any advantage. The idea was that canes planted in October will ripen early, and will thus be safe from the ravages of frost, which kill the ripened cane and decrease the sugar contents. Of these five, however, only Katha and Dhauru survived. The crop ripened about the same time and the results are not in favour of early sowings. The outturns too are not very good. Katha gave 19 maunds and 14 seers per acre. It was much damaged by rats and was badly lodged. Dhauru yielded 28 maunds and 19 seers per acre.

There appears no advantage in early sowings.

5. *Cottons*.—The object of experiments with cottons was explained in the last year's report. The Economic Botanist's three varieties and Cambodia cotton were again grown this year. The germination in Cambodia cotton was very poor; it is being discarded. Mr. Milne's cottons did fairly well. American was late and did not yield well.

6. *Maize*.—The excessive rains last monsoon ruined the experiments in this crop. It was believed that rains after sowing would spoil the germination of crop sown in lines. To avoid this, it was sown in the end of May. The germination was again irregular. The outturn was 10 maunds and 19 seers per acre. The crop was sown rather early: it has been put in later this (1915) year.

The comparative test between Jullundur and the local seed was altogether spoiled by the excessive rains: it will be continued.

7. *Rabi*.—*Gram*.—Gram was killed by wet weather and root-rot.

8. *Wheat*.—Came in the usual rotation after sugarcane. Comparative tests between Pusa 12, Punjab 17, 14, 13 and 11; local 13, Farm 13 and local 16 were carried out. Experiments with artificial manures and green manuring were also conducted in the chahi area, but as the season was very wet, little irrigation was resorted to; the results are discussed under the wheats in the barani area.

Batala Wadanaks (*Indicum Durans*) were again tried this year, but the grains were very shrivelled and the outturn poor. They will be tried again. The Imperial Economic Botanist sent 3 mixtures, 2 of crosses on Pusa 6 and one of crosses on Pusa 4, to see which type is likely to do well here. He saw these growing in February: one has been retained: it will be grown next year on ordinary soil in the barani area.

9. *Barani area*.—Area, rotation and the object of the experimental work in this area is given in 1913-14 report.

10. *Kharif*.—*Mash* (*Phaseolus Mungo*). It is a common legume in the district; it generally follows a rabi crop. The crop was good, but rains at harvesting reduced the outturn considerably. Sowing in lines *versus* broadcasting was again tested this year. The season was excessively wet and no definite results were obtained. The yields per acre are below:—

Broadcasted	...	...	5 maunds 38 seers	} per acre.
Drilled	...	...	6 maunds 1 seer.	

The outturn on the average was 6 maunds 14 seers per acre. But it must not be forgotten that this was a very unusual year of rainfall.

11. *Wheat*.—In paragraph 2 the abnormal character of the season has been already described; it specially affected the very important wheat crop: hence but little reliance can be placed on the results of the experiments carried out in this crop this year. The following experiments were conducted in wheat:—

1. Effect of artificial manures.
2. Green manuring and green manuring plus artificial manures. (This experiment was conducted in chahi area).
3. Cultivation experiments.
4. Comparative tests between different local types and Pusa wheats.
5. Seed rate experiments with Pusa wheats.
12. *Effects of artificial manures*—Statement No. 3.
 - (a) Superphosphate $1\frac{1}{2}$ cwt. per acre *versus* no manure.
 - (b) Superphosphate top dressing $1\frac{1}{2}$ cwt. per acre *versus* no manure.
 - (c) Bone meal 5 cwt. per acre *versus* no manure.
 - (d) Sodium Nitrate 2 cwt. per acre *versus* no manure.

The manured plots gave a higher outturn than the unmanured plots, but the increase does not cover the cost of the manures and does not justify the use of any artificial manures. In manured plots the quality of grain was slightly improved. Superphosphate made the crop earlier by nearly a week, which was a great advantage. This was the principal object with which this manure was tried. There was rather bad rust in manured plots, as compared to unmanured. All the manures will be again tried next rabi.

13. *Green manuring*.—Statement No. 4.—Like chemical manures green manuring increased the outturn, but the increase is not sufficient to compensate for the expense and trouble of green manuring, superphosphate was also added to one green manured and one unmanured plot at $1\frac{1}{2}$ cwt. per acre. The outturn has been slightly increased, but the results are not very encouraging. The year, however, was entirely abnormal.

14. *Cultivation experiments.—Statement No. 5.*

- (a) Hot weather cultivation *versus* ordinary cultivation.
 - (b) Nine inches deep ploughing *versus* 4½ inches deep ploughing.
- Results inconclusive, owing to the abnormal year.

15. *Comparative tests.—Statement No. 6.*

- (a) Pusa 4, 6 and 12 were tested against Punjab 14. (This is one of the two predominant local types).
- (b) Pusa 12 against Punjab 14.
- (c) Pusa 12 against Punjab 13. (This is the second very common type in this district).
- (d) Local 13, farm seed of the same type and local 16 were tested against one another. The seed of farm 13 was obtained from Lyallpur in 1910, where the Punjab wheats were classified: it appears to be slightly different to the local 13, and is rather later than it. Local 13 gave better results than the farm 13, being both healthier and less affected by rust.

Pusa 4 and 12 did quite well. Pusa 6 was so badly rusted and so poor looking that it was discarded and fed to cattle. Pusa 12 fared no better and no worse than Punjab types as regards rust, but as regards outturn it was better. Last year's belief that Pusa 12 does better on good soils and fares worse on poor soils was confirmed (*vide* outturns of fields No. 1 and No. 3).

In order to see how late sowing will affect Pusa 12 and to find how late it can be sown, it was sown on 19th November 1914, which is fairly late, in field No. 33. The crop however was not late at all: it ripened with the others and the grain was of a better quality. The outturn it is true was low, but much importance need not be attached to this, as this field had always been under chari and was poor.

16. *Seed rate experiments with Pusa 4 and Pusa 12.—Statement No. 7.*—Pusa wheats tiller less than local types, and should be sown at an higher seed rate than is common with us. In order to find out the desired quantity of seed to be sown per acre, these wheats were sown at different seed rates, with 16 seers, 20 seers, 25 and 30 seers per acre. Twenty seers per acre appears to be a suitable seed rate for these wheats in poor soil, as was the field in which this experiment was conducted.

17. *Pusa wheats Nos. 4 and 12.*—Both these wheats have done well in spite of the abnormal season. Pusa 4 is the more promising; either it or one of its crosses appear to be the right wheat for this province. Its outturn was tested on a fairly large area. It yielded 16 maunds 23 seers to the acre. It was almost free from rust; but the weather affected the grains; about 2 per cent. of which were bunted, which is rather discouraging, as bunt in wheat is almost unknown in the province, and any wheat which is bunted however promising it may be, should be discarded as a general rule for that defect alone, as it may do more harm than good in spreading this disease. But as the season was favourable for this fungus, we will hope for better results in future. When overripe it sheds its grain easily, and should be harvested early.

Both Pusa 12 and Pusa 4 are white grained wheats with large heads and produce plump grains, which give a uniform and pleasing sample. Their outturn has been higher than the local type. This conclusion has been confirmed by the results obtained by zemindars outside the farm, where they have everywhere given from 3 to 5 maunds per acre more than local wheats. The only objection to their cultivation on a very extensive scale is that they shed their grains very easily and being beardless, are more easily damaged by birds and wild animals. They are moreover too early to be grown mixed with gram, which is a common mixture in most of the barani areas. Further as they ripen early and all at once, no zemindar can have more than ½rd or at the most half of his wheat area under them, for if they are allowed to stand when ripe, the grain sheds in the field.

18. *Poultry.*—As the foreign birds imported to Lyallpur did not fare well there, some varieties are being tried here: for the present we are confined to the black Leghorn. It is doing well. One cock has been given to a neighbouring village to improve the local breed.

19. *Implements.*—The Massey flexible harrow is giving better and more satisfactory results than the chain or peg toothed harrows. It is about of the right weight, and fits the hollows as well as a chain harrow; which peg toothed harrows will not do. It will be given a good trial next year. Lever peg toothed harrows have been found very useful and economical for the first (blind) and second hoeing of sugar-cane.

20. *Fertilizers*.—In neighbouring lands sodium nitrate was tried on 4 plots of poor wheat fields, where wheat followed rice in Nowanpind near Gurdaspur in the end of December. It rained two days after the application of the manure. The idea was to see its effect upon the outturn and growth of wheat in poor soils. The results obtained are as follows :—

Plot.	Area.	ACTUAL OUTTURN			OUTTURN PER ACRE.		
		Grain		Straw.	Grain.		
		Mds.	Srs.	Bundles.	Mds.	Srs.	
Manured ...	9½ kanals ...	6	8	16	6	15	
Unmanured ...	Dittq ...	5	0	12	5	5	
					Mds.	Srs.	
Increase of grain in the manured plot per acre ...					1	10	
Increase of Bhusa ...					3	0	
							Rs. A P.
Price of grain at Rs. 3-8-0 per maund ...					4	6	0
Price of Bhusa at Rs. 0-6-3 per ..					1	3	0
							Total increase in cash
					5	9	0
Price of manure per acre...					11	4	0
Therefore loss per acre ...					5	11	0

The stimulating effect of manure was quite visible from the look of the crop; the manured wheat being darker in colour, but a few days late in ripening.

21. *Visitors*.—The farm is now increasing in popularity and officials and zemindars from various parts of the Province often visit it. Mr. Burton, the Deputy Commissioner of Karnal with his revenue officials and a selected number of zemindars and zaildars visited it in April 1914. The Revenue Assistant of Lahore, with his tahsildars and a number of zaildars also paid a visit in April. Visitors are shown over the farm and the work going on explained. The meetings of the Gurdaspur agricultural association were held on the farm: members were shown over the farm.

22. *General.*—The Ashford tube well is giving every satisfaction. It is at present run by a steam engine, which is rather expensive. An oil engine has been purchased, and will be erected very soon. The water channels have been improved and 590 feet of masonry channel laid out.

Some 2 acres of farm land all laid down for grass experiment. Matriculation students of the Khalsa Collegiate School and the Government High School, Gurdaspur, attended the farm once a week in winter for practical agricultural training.

M. FATEH-UD-DIN:

Offg. Deputy Director of Agriculture.

Statement No. 1.

RAINFALL DURING THE YEAR 1913-14 AND 1914-15.

Name of Month,	Rainfall during 1913-14.	Rainfall during 1914-15.
June	4.47	4.44
July	8.32	31.92
August	3.65	2.05
September	...	5.03
October	.05	3.45
November	...	.59
December	1.78	1.85
January	.67	2.21
February	2.01	4.63
March	1.42	2.30
April	3.40	.47
May	1.83	...
Total	27.60	58.92

STATEMENT No. 2.—SUGARCANE VARIETIES.

Serial No.	No. of field.	No. of plot.	Name of variety.	Area harvested in square yards.		WEIGHT OF CANES.		WEIGHT OF JUICE.		WEIGHT OF GUR.		WEIGHT OF SHAKKAR.		WEIGHT OF CANES PER ACRE.		WEIGHT OF GUR PER ACRE.		WEIGHT OF SHAKKAR PER ACRE.		Percentage of juice to cane.		Percentage of gur to juice.		Percentage of shakkar to juice.		Percentage of shakkar to cane.		REMARKS.
				Mds.	Srs.	Mds.	Srs.	Mds.	Srs.	Mds.	Srs.	Mds.	Srs.	Mds.	Srs.	Mds.	Srs.	Mds.	Srs.	Mds.	Srs.	Mds.	Srs.	Mds.	Srs.	Mds.	Srs.	
1	5	14	Lal Hard	771	29	29	28	4	8	1	1	1	1	318	17	190	13	32	27	33	5855	1754	1043	1788	1012	1012		
2	5	13	Kasara	985	33	32	...	...	...	5	5	5	5	254	26	157	10	...	...	26	6174	...	...	1711	1056	...	...	
3	5	12	Bodi	889	22	38	...	...	...	3	3	3	3	384	4	206	35	...	...	32	5396	...	...	1672	846	...	...	
4	5	11	Dhanlu of Bham	545	6	25	...	...	...	...	...	...	...	418	6	222	...	...	...	32	5502	...	...	1470	78	...	...	
5	5	10	Kabu	783	93	59	35	7	19	...	...	...	...	576	21	370	23	46	10	46	6428	1248	802	...	784	...	...	
6	5	9	Reora of Benares	864	13	62	32	4	26	12	12	12	12	595	25	351	34	53	29	31	5906	1528	902	...	...	...	...	
7	5	8	Kansar	1,074	3	61	15	9	15	...	...	...	...	441	39	275	28	42	10	40	6257	1527	955	...	...	...	...	
8	5	7	Merthi	1,100	97	61	35	7	39	...	...	...	...	427	31	272	10	35	4	...	6364	1248	82	...	...	...	...	
9	5	6	Suretha	778	71	29	41	6	39	...	...	...	...	446	8	288	13	43	15	...	6789	1679	97	...	...	...	...	
10	5	5	Dhaura of Azamgarh	549	48	14	21	...	...	18	18	18	18	426	10	193	29	...	...	30	4545	...	...	1569	713	...	...	
11	5	4	Tareu	1,060	33	53	26	7	20	9	9	9	9	428	12	242	33	25	9	36	6719	...	...	150	857	...	...	
12	5	3	Chin	1,072	93	14	54	8	25	...	...	...	...	421	18	243	4	38	38	12	5885	1569	924	...	...	...	...	
13	5	2	Matki Mangy	1,107	94	26	59	9	...	...	...	...	...	413	33	259	4	39	14	...	6259	1519	951	...	...	...	...	
14	5	1	Katha of Bafala	904	60	7	34	5	...	...	...	...	...	322	7	184	7	39	10	...	5716	1642	836	...	...	...	...	
15	10 B	7	Katara	441	30	8	17	...	...	2	2	2	2	331	18	193	39	29	2	27	5852	150	878	1397	815	...	...	
16	10 B	6	Betakali of Dauraoon	589	45	39	25	...	...	3	3	3	3	435	1	241	21	...	...	34	28	...	...	1437	797	...	...	
17	10 B	6	Patarki Mangy	396	41	27	20	2	...	39	1	1	1	509	14	243	5	33	18	34	30	4907	150	736	1918	...	...	
18	10 B	6	Barhai	560	46	32	25	...	...	13	13	13	13	404	19	222	5	33	36	32	5491	1527	837	1472	809	...	...	
19	10 B	5	Manch of Basati	529	61	10	33	4	...	...	...	...	...	560	15	301	37	39	5	44	5388	1295	698	...	...	...	...	
20	10 B	5	Sanachi of Dauraoon	459	55	22	22	...	...	7	7	7	7	570	26	320	3	43	1	...	5981	1333	80	1391	832	...	...	
21	10 B	4	Behar	310	35	22	...	...	...	...	...	...	...	569	19	333	19	52	19	...	6019	1420	921	...	...	...	...	
22	10 B	3	Sunabali	535	46	36	30	3	...	...	...	...	...	565	18	323	18	47	6	45	5388	1578	719	...	...	...	...	
23	10 B	2	Mango	823	111	18	55	5	...	20	...	...	...	655	33	274	37	41	26	...	5915	1515	896	...	...	...	...	
24	10 B	1	Desi Suretha	1,130	108	21	64	4	...	...	...	...	...	513	26	308	17	35	14	...	6005	1146	688	...	...	...	...	
25	10 A	7	Dhaura	1,102	116	38	70	8	...	...	...	...	...	306	28	189	11	21	4	...	6171	1115	67	...	...	...	...	
26	10 A	6	Kinara	1,049	68	19	41	14	...	...	...	...	...	481	23	274	18	32	12	...	5699	1174	67	...	...	...	...	
27	10 A	5 and 2	Dhanlu Local	2,098	208	30	118	14	...	...	...	...	...	489	21	291	16	38	33	...	5958	1332	793	...	...	...	...	
28	10 A	...	" Suretha	240	24	11	14	1	...	...	...	...	...	489	21	291	16	38	33	...	5958	1332	793	...	...	...	...	
29	10 A	...	Katha (cross-drained)	235	11	29	7	...	...	...	...	...	...	252	9	155	34	19	14	...	6183	1241	759	...	...	...	...	
30	6 D	...	Dhanlu (winter sown)	255	20	5	11	...	...	...	...	...	...	381	39	226	33	24	19	...	5938	1255	745	...	...	...	...	
31	...	...	Dhanlu (cross-drained)	714	64	24	39	4	...	...	...	...	...	437	36	264	15	31	7	...	6037	1179	712	...	...	...	...	

Effect of Chemical Manures on wheat yields.

Field No. 18	Ploughing	... 4	Harrowing	... 16	Solhagaing	... 12	Wheat harrowing	... 3	Date of sowing	... 3rd-4th November 1914.	Date of harvesting	... 16th-27th-28th-29th April 1915.
Field No. 23	Ploughing	... 1	Harrowing	... 2	Solhagaing	... 7	Wheat harrowing	... 2	Date of sowing	... 19th November 1914.	Date of harvesting	... 15th April 1915.

Statement No. 4.

STATEMENT SHOWING THE EFFECT OF GREEN MANURING ON WHEAT.

No. of field with plot.	Variety.	Area in square yards	Treatment.	ACTUAL OUTPUT.				OUTPUT PER ACRE.				REMARKS.	
				Grain.		Straw.		Grain.		Straw.			
				Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.		
3 6, 8, 10, 12, 14 3 1, 7, 9, 11, 13 3	Pusa 12	3,935	Green Manuring ...	5	6	21	32	6	13	26	33	Ploughings ...	... 2
	"	3,935	No Manure ...	5	8	21	16	6	16	26	13	Cutaway disc harrow ...	... 2
	"	787	Green Manuring + Superphosphate 1½ cwt. per acre.	1	4	6	15	6	31	39	8	Harrowings ...	... 8
	"	787	Superphosphate 1½ cwt. per acre...	1	0	5	25	6	6	34	24	Sohagaing ...	... 7
	"	787	Green Manuring ...	0	39	5	13	6	0	32	30	Wheat harrowing ...	... 1
	"	787	No Manure ...	0	20	5	1	3	3	30	36	Date of sowing, 10th November 1914.	
3 6, 8, 10, 12, and 14 3 1, 7, 9, 11, 13 3	Punjab 17	3,935	Green Manuring ...	4	34	27	14	5	38	33	26	Date of harvesting, 19th-21st April 1915.	
	"	3,935	No Manure ...	4	10	27	30	5	9	34	5		
	"	787	Green Manuring + Superphosphate 1½ cwt. per acre.	0	30	6	38	4	24	42	30		
	"	787	Superphosphate 1½ cwt. per acre	0	21	5	23	3	9	34	11		
	"	787	Green Manuring ...	0	26	5	18	4	0	33	21		
	"	787	No Manure ...	0	23	5	3	3	21	31	8		

4	6, 8, 10, 12, 14	4	Punjab 14	2,625	Green Manuring	...	...	...	8	18	7	13	33	22	Ploughings ...	...	...	2
4	1, 7, 9, 11, 13	4	"	2,625	No Manure	...	...	...	3	16	6	39	30	30	Outaway disc harrow	...	...	1
2	4	4	"	525	Green Manuring + Superphosphate 1½ cwt. per acre.	...	...	...	0	8	6	9	29	2	Harrowings ...	...	...	8
3	4	4	"	525	Superphosphate 1½ cwt. per acre	...	...	...	0	2	32	37	25	33	Wheat harrowing	...	...	1
4	4	4	"	525	Green Manuring	...	...	...	0	3	5	3	28	14	Schagaing ...	...	...	7
5	4	4	"	525	No Manure	...	...	...	0	2	4	24	25	14	Date of sowing, 9th-10th November 1914.			
4	6, 8, 10, 12, 14	4	Punjab 13	2,625	Green Manuring	...	...	...	3	17	30	27	32	29	Date of harvesting, 22nd, 23rd, 24th April 1915.			
4	1, 7, 9, 11, 13	4	"	2,625	No Manure	...	...	...	3	25	6	20	46	31				
2	4	4	"	525	Green Manuring + Superphosphate 1½ cwt. per acre.	...	...	...	0	6	24	21	60	31				
3	4	4	"	525	Superphosphate 1½ cwt. per acre	...	...	...	0	5	6	31	47	19	N.B.—Burying of green manure is not included in the ploughings given.			
4	4	4	"	525	Green Manuring	...	...	...	0	4	23	21	42	7				
5	4	4	"	525	No Manure	...	...	...	0	4	11	18	39	16				
4	6, 8, 10, 12, 14	4	Punjab 14	2,625	Green Manuring	...	...	...	4	29	7	25	53	37				
4	1, 7, 9, 11, 13	4	"	2,625	No Manure	...	...	...	3	28	7	6	51	31				
2	4	4	"	525	Green Manuring + Superphosphate 1½ cwt. per acre.	...	...	...	0	5	33	7	53	28				
3	4	4	"	525	Superphosphate 1½ cwt. per acre...	...	...	...	0	5	12	15	43	34				
4	4	4	"	525	Green Manuring	...	...	...	0	4	33	31	44	19				
5	4	4	"	525	No Manure	...	...	...	0	5	18	24	50	10				

Statement No. 5.

STATEMENT SHOWING THE EFFECT OF CULTIVATION ON WHEAT.

No. of field.	Area.	Name of variety.	Cultivation.	ACTUAL OUTTURN.				OUTTURN PER ACRE.				REMARKS.					
				Grain.		Straw.		Grain.		Straw.							
				Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.						
18	2,457	Punjab 13	...	...	...	...	...	...	...	...	...	...	Ploughings	...	...	...	4
	2,457	Do.	...	...	...	...	...	...	...	...	...	...	Harrowings	...	...	...	16
	2,457	Punjab 14	...	...	...	...	...	...	...	...	...	...	Sohagating	...	...	...	12
	2,457	Do.	...	...	...	...	...	...	...	...	...	...	Wheat harrowings	...	...	...	8
	2,457	Punjab 13	...	...	...	...	...	...	...	...	...	...	Date of sowing, 3rd—4th November 1914.	...	...	...	3
	2,457	Do.	...	...	...	...	...	...	...	...	...	...	" " harvesting, 16th, 27th, 28th, 29th April 1915.	...	...	...	...
17	2,457	Punjab 14	...	...	...	...	...	...	...	...	...	...	Ploughings	...	...	...	2
	2,457	Do.	...	...	...	...	...	...	...	...	...	...	Harrowings	...	...	...	11
	2,457	Punjab 14	...	...	...	...	...	...	...	...	...	...	Sohagating	...	...	...	9
	2,457	Do.	...	...	...	...	...	...	...	...	...	...	Wheat harrowing	...	...	...	...
	2,376	Pusa 12	...	...	...	...	...	...	...	...	...	...	Date of sowing, 5th November 1914.	...	...	...	...
	3,224	Do.	...	...	...	...	...	...	...	...	...	...	Date of harvesting, 16th April 1915.	...	...	...	...

Statement No. 6.

COMPARATIVE TEST OF WHEATS.

Field.	Type No.	Actual area reaped in square yards.	ACTUAL OUTTURN.				OUTTURN PER ACRE.				REMARKS.
			Grain.		Straw.		Grain.		Straw.		
			Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
18	Punjab 13	1,638	0	33	6	14	2	18	18	31	Ploughings 4 Harrowings 16 Sohagating 12 Wheat harrowings 3 Date of sowing, 3rd, 4th November 1914. Date of harvesting, 16th, 27th, 29th April 1915.
	Pusa 4	1,638	2	1	7	12	5	39	21	23	
	" 4	2,245	6	28	23	11	14	18	50	7	
	" 12	2,913	5	10	16	21	8	29	27	18	
22	Punjab 14	3,302	3	26	22	22	5	14	33	2	Ploughings 4 Harrowings 1 Sohagating 13 Wheat harrowings 3 Date of sowing, 7th, 8th November 1914. Date of harvesting, 14th, 16th, 24th May 1915.
	Pusa 12	6,254	4	36	17	4	3	32	13	9	
	Punjab 13	6,254	5	32	22	25	4	20	17	20	
	Pusa 12	11,815	14	35	60	3	0	4	24	24	
16	Punjab 14	11,815	14	38	79	6	6	5	32	17	Ploughings 4 Harrowings 20 Sohagating 9 Wheat harrowings 3 Date of sowing, 6th November 1914. Date of harvesting, 14th, 26th April 1915.
	Local 13	1,536	2	10	13	24	7	4	42	34	
	Punjab 13	1,656	1	31	16	0	5	8	46	31	
	Local 16	1,814	1	24	16	1	5	36	59	1	Ploughings 4 Harrowings 15 Sohagating 10 Wheat harrowings 4 Date of sowing 7th November 1914. Date of harvesting, 20th, 22nd, 29th April 1915.

Statement No. 7.

STATEMENT SHOWING THE RESULT OF DIFFERENT SEED RATES.

No. of field.	Variety.	Seed rate per acre.	Treatment.	Area in square yards.	ACTUAL OUTPUT.				OUTPUT PER ACRE.				REMARKS.
					Grain.		Straw.		Grain.		Straw.		
					Mounds.	Seers.	Mounds.	Seers.	Mounds.	Seers.	Mounds.	Seers.	
14	Pusa 4	16 seers	No manure	640	1	9	3	9	9	11	24	16	Ploughing = 4. Harrowing = 21. Sowing = 10. Wheat harrowing = 8. Date of sowing 8th-9th November 1914. Date of harvesting, 17th April 1915.
"	"	"	Sodium Nitrate 1 cwt.	568	1	5	3	18	9	23	29	16	
"	"	20 seers	No manure	632	1	14	3	38	10	18	30	10	
"	"	"	Sodium Nitrate 1 cwt.	568	1	13	4	13	11	12	36	34	
"	"	25 seers	No manure	634	1	11	3	28	9	29	28	9	
"	"	"	Sodium Nitrate 1 cwt.	573	1	10	3	28	10	22	31	10	
"	"	30 seers	No manure	617	0	21	2	2	8	1	31	12	
"	"	"	Sodium Nitrate 1 cwt.	284	0	25	2	11	10	26	38	31	
Pusa 12	"	16 seers	No manure	668	0	29	2	10	5	10	16	13	
"	"	"	Sodium Nitrate 1 cwt.	609	0	25	1	39	4	39	15	28	
"	"	20 seers	No manure	668	0	29	2	15	5	10	17	8	
"	"	"	Sodium Nitrate 1 cwt.	604	0	24	2	2	4	32	16	17	
"	"	25 seers	No manure	671	0	27	2	12	4	33	16	24	
"	"	"	Sodium Nitrate 1 cwt.	607	0	21	1	35	4	7	14	38	
"	"	30 seers	No manure	384	0	11	1	9	3	39	17	30	
"	"	"	Sodium Nitrate 1 cwt.	302	0	10	1	2	4	0	16	33	

APPENDIX VIII.

Report of the Deputy Director of Agriculture on the Hansi Farm.

(1) *Introductory.*—I took over charge of my duties at Hansi in the beginning of October 1914. Till that date the farm there was under the charge of the Assistant Director of Agriculture and the Manager under the supervision of the Deputy Director of Agriculture, Gurdaspur, since its start in the spring of 1914.

(2) *Season and its effects.*—The total rainfall of the year was 20·93 inches as compared with 7·31 inches last year and 15·24 inches, the average rainfall of the district. Summer rains benefited the kharif crops: but a small downpour at the end of October after the sowing of wheats prevented their germination: save some Pusa 12, which was sown shallower. The rains of February and March helped the rabi crops though they came rather late: they washed away the rust that had appeared. The later rains, however, accompanied as they were by high winds, caused the wheats to lodge badly. As a result the grain was shrivelled and light. The cotton germination was not very satisfactory owing to the heavy rain at the beginning of April which produced a crust on the surface. The season on the whole was favourable except for occasional hailstorms.

(3) *Buildings.*—The farm is still in the kacha buildings. A pucca cattle pound has been recently completed.

(4) *Aim of the farm.*—The farm is primarily for cotton. It lies about three miles to the north of Hansi town in the Hansi Bir.

(5) *Soil.*—Much of soil is saline, poor and of uneven quality throughout. This is unfortunate, but it is typical of the district. Weeds, especially convolvulus, grow luxuriantly.

(6) *Area.*—The area of the farm, excluding roads, water channels and buildings, is about 200 acres. Half of it is under the direct management of the department, while the other half is to be leased out to tenants under our control.

(7) *Laying and levelling the farm area.*—The area intended for cultivation of the farm has practically been laid out: that of the tenants is in progress. A good deal remains to be done here.

(8) *Tenants.*—There were seven tenants last year. They were all Gujars and bad agriculturists. Search is being made for better tenants. Till houses are provided for them, they will not be forthcoming.

(9) *Cropping scheme and rotations.*—A permanent cropping scheme of blocks A (2 portions), B and C under the direct farm cultivation has been drawn up, and rotations started as follows:—

Block A 1.—12 acres, wheat, fallow, cotton, fallow.

Block A 2.—9 acres, wheat, cotton, senji, sugarcane, fallow.

Block B.—20 acres, wheat, cotton, senji, fallow.

Block C.—22 acres, cotton, fallow, jowar, fallow.

(10) *Cottons.*—(Statement Nos. 2 and 3).—The land on which the cottons were grown was poor and of uneven quality in many parts and was also infested with patches of kallar where no plants ever germinated. There were 15 acres under different cotton varieties. One and half acres were put in under 4 F. American cotton, 2 acres under Rosea 87, 2 acres under Mollisoni 24, 1 acre under sanguineum 20 A, $\frac{1}{2}$ acre under Indicum 135 A, and 6 acres under local Bhatla. Besides this 1 acre was put under 3 varieties of the Economic Botanist for environment experiments. All the cottons were sown in lines behind the plough, except 3 acres of local Bhatla which were broadcasted for comparative results. The germination was thin, as it was impeded by the crust produced by the rain of April 5th just after sowing was over. The saline patches also had much effect on the germination.

Root rot was very troublesome and many plants died. The cotton also suffered from the hail of the 8th of May, and from violent wind and rain from 17th to 20th September. Considering all things the cottons did well on the whole. Both American and desi varieties began to open from about the middle of September and continued till 10th December when the last picking was made. For yields see statements Nos. 2 and 3.

The white flowered varieties Mollisoni and Rosea will probably find a large scope for multiplication as they yield well, and give a good ginning percentage. American cotton can also be grown with success here. All the above-mentioned varieties are being grown this year for comparative tests of outturn.

The sowing of cotton in lines behind the plough cannot advantageously be effected here after the 15th April owing to the hot winds which dissipate the moisture.

(11) From the local Bhatla cotton plot seed of the four different desi varieties was separated last year: and each is now being grown separately on an acre plot.

(12) *Parasite breeding plot*.—A permanent plot of cotton for breeding the bellworm parasite is being maintained on the farm by the Entomological section.

(13) *Gowar*.—Some six acres of gowar were grown with rain moisture for seed purposes in old patches. The crop was rather too thick and tall. The outturn was 8 maunds 29 seers per acre.

(14) *Jowar (Sorghum)*.—The jowar was grown merely for the supply of fodder to the farm cattle. A silage experiment with jowar will be made in the next season.

(15) *Wheat*.—(Statement No. 4).—Wheat was the principal crop of the rahi. The original germination was defective as already described, save on one plot of Pusa 12. The other plots had to be re-sown. The rain in February and March helped in stimulating the growth and washing down the rust that had appeared, but also caused the crop to lodge very badly. The Pusa wheats tillered poorly as compared with the Punjab wheats: but Pusa 12 was much better in this respect than Pusa 4. The stand of Pusa wheats was better than the Punjab wheats and the grains are very attractive to the eye. The local seed rate here is about a maund per acre but the farm used up to 30 seers. Pure heads of each of the four varieties of wheat were picked out to give sufficient seed for three or four acres, which will be grown separately next year.

The general custom here is to sow the wheats by means of the drill, using no sohaga after. Experiments will be tried next season to sow the wheats by means of the drill at such a depth that sohaga, a harrow and a reaping machine may afterwards be worked with advantage.

The tenants' wheats were poor in general: one, however, yielded 18 maunds 32 seers per acre.

(16) *Grams*.—(Statement No. 5).—Ten acres of early grams, and three of late grams (sown in November) were grown. The vegetative growth of the early sown grams was tremendous and chopping *versus* unchopping and nipping experiments were carried out. The outturn of all the plots chopped with the sickle and nipped by hand was more than the one left unchopped. The yield of the early sown grams range from 23 maunds 1 seer to 16 maunds 24 seers per acre or 20 maunds 35 seers on an average of seven acres. The late sown grams were badly attacked by root rot owing to the land being saline: the outturn was very poor, varying from 11 maunds 22 seers to 6 maunds 7 seers per acre.

(17) *Barleys*.—(Statement No. 8).—The barleys were grown on an area of 5 acres in odd corners. The crop was a little late and suffered much from not being watered in time owing to the scarcity of water in the canal; yet the outturn per acre is about 24 maunds which is satisfactory.

(18) *Senji and Metha*.—(Statement No. 6).—One acre of senji and 6 acres of metha were grown for comparative tests. Four acres of metha were ploughed in as green manuring for sugarcane and American cotton. The remaining 2 acres of metha and 13/24 acre of senji were cut green and given to cattle. The green stuff obtained per acre from a plot of senji is about 275 maunds, or half as much again as the outturn from a similar area of metha. Senji does well here.

(19) *Japan rapes*.—(Statement No. 7).—The two varieties of Japan rape,—black leaved and white leaved,—were grown for fodder purposes only. The black leaved variety is slow growing: the other is quick growing. Two cuttings from each of the varieties were taken. The black variety gave very poor yield in the second cutting. It is also more liable to attacks from aphids and frost.

(20) *Shaftal and Berseem*.—These were sown, but did not do well owing to the land being saline.

DARSHAN SINGH,

Deputy Director of Agriculture, Punjab.

STATEMENT NO. 1.—*Showing the rainfall during the years 1913-14 and 1914-15*
(data obtained from the Hansi Tahsil and District Office, Hissar).

1	2	3
Name of month.	Rainfall during 1913-14.	Rainfall during 1914-15.
June	1.38	1.23
July	2.36	8.17
August	0.64	2.36
September	0.65	3.48
October	...	1.07
November	0.01	...
December	0.24	...
January	...	0.20
February	0.46	2.29
March	...	1.53
April	0.82	...
May	0.75	0.60
	7.31	20.93

STATEMENT No. 2.—Showing the outturns of different varieties of cotton during Kharif 1914, on the Hansi Agricultural Station.

No. of block and plot.	Name of variety.	Area in acres.	DATE OF			ACTUAL OUTTURN.		OUTTURN PER ACRE.		Khan of lint in seers per maund of cotton (kapes).	REMARKS.
			Sowing.	First picking.	Last picking.	Maunds.	Seers.	Maunds.	Seers.		
* $\frac{1}{1}$	4 E. American	1 $\frac{1}{2}$	27-28th March 1914.	16th September 1914.	10th December 1914.	17	32	11	35	11 $\frac{3}{4}$	Slightly damaged by root rot. Otherwise fair stand of crop.
* $\frac{2}{2}$	Indicum 185 A	1 $\frac{1}{2}$	31st March 1914.	16th September 1914.	10th December 1914.	3	18	6	36	10 $\frac{9}{16}$	Does not open well, seed not well covered. Lint hard and rough.
* $\frac{4}{4}$	Mollisoni 24	2	2nd April 1914.	16th September 1914.	10th December 1914.	19	11	9	26	15	Opens well, seed well covered. Lint short and rough.
* $\frac{5}{5}$	Sanguineum 20 A	1	2nd April 1914.	16th September 1914.	10th December 1914.	3	2	3	2	12 $\frac{3}{16}$	Crop fair except on a large patch of Reh soil. Lint short.
* $\frac{6}{6}$	Rosea 87 (Neglectum white flowered)	2	3rd April 1914.	16th September 1914.	10th December 1914.	20	9	10	5	13 $\frac{13}{16}$	Crop thin owing to crust after sowing. Good many plants of other types were rogued out. Otherwise good stand. Lint fair.
* $\frac{7}{7}$	Local Bhatla in lines	3	4th April 1914.	16th September 1914.	10th December 1914.	32	22	10	34	13	Half the crop fair, half thin owing to an attack of root rot and saline patches. On the whole crop fairly good.
* $\frac{8}{8}$	Local Bhatla broadcast	3	10th April 1914.	23rd September 1914.	10th December 1914.	41	8	13	29	13	Crop good and regular.

N.B.—(a) The land was ploughed up twice by the zamindars with country plough before it was taken by the department. In addition to this the plot of American cotton received one ploughing with Rajah plough and one harrowing; the rest of the desi cotton fields received one ploughing with country plough and a harrowing before sowing.

(b) All the cottons, American and desi, sown in lines were hoed up with country kasola sance, and with horse-hoe twice. The broadcast local Bhatla cotton was hoed up with country kasola tarica.

(c) Except local Bhatla cotton both in lines and broadcast which got three irrigations, the others were given four waterings.

STATEMENT No. 3.—Showing the outturn of Mr. Mine's varieties for environment experiment grown on the Hansi Agricultural Station, during Kharif 1914.

No. of block and plot.	Name of variety.	Area in acres.	DATE OF			ACTUAL OUTTURN.		OUTTURN PER ACRE.		REMARKS.
			Sowing.	First picking.	Last picking.	Maunds.	Seers.	Maunds.	Seers.	
* 9	Mulani	3	11th April 1914 ...	23rd September 1914.	25th November 1914.	3	25	10	35	Crop good and regular.
* 9	199 F. American	3	11th April 1914 ...	10th October 1914	25th November 1914.	3	39	11	37	Ditto.
* 9	Luskeum 133 b	3	11th April 1914 ...	30th September 1914.	29th November 1914.	1	18	4	14	Crop very thin owing to its being badly attacked by root rot.

N. B.—(a) The land was ploughed up twice with the country plough before it came into possession of the farm. In addition to this it received one more country plough and harrow before the sowing was done.
(b) It got one hoeing with country Kasola and 2 with horse hoe.
(c) Only three irrigations were given.

STATEMENT No. 4. Showing the outturn of wheat varieties grown on the Hansi Agricultural Station, during Rabi 1915.

Block No.	Plot No.	Area in acres.	Name of varieties.	Previous crop.	TREATMENT		Number of waterings given.	DATE OF		ACTUAL OUTTURN OF				OUTTURN PER ACRE OF				REMARKS.
					Before sowing.	After sowing.		Sowing.	Harvesting.	Grain.	Bhusa.	Grain.	Bhusa.	Grain.	Bhusa.	Grain.	Bhusa.	
										Mauuds.	Seers.	Mauuds.	Seers.	Mauuds.	Seers.	Mauuds.	Seers.	
A	1	1	Punjab type, No. XIV ...	Fallow ...	Raja plough = 3 Harrow ... = 5	Pig-toothed Harrow twice.	3	27th October 1914 and 8th November 1914.	16th April 1915 ...	18	23	64	30	18	23	64	30	Germination good. Tillering good. Rust appeared, but was washed away by rains which caused the crop to lodge.
A	2	1	Punjab type, No. XI ...	Do. ...	Ditto.	Ditto.	3	Ditto.	10th April 1915 to 17th April 1915.	20	13	56	30	20	13	56	30	Ditto.
A	3	1	Pusa, No. 12	Do. ...	Ditto.	Ditto.	3	27th October 1914 and 15th November 1914.	10th April 1915 to 16th April 1915.	15	2	47	23	13	2	47	23	Tillering not good, but better than Pusa 4.
A	4	1	Pusa, No. 4	Do. ...	Ditto.	Ditto.	3	28th October 1914 and 8th November 1914.	13th April 1915 to 16th April 1915.	23	30	65	22	23	30	65	22	Tillering poor.
A	5	1	Pusa, No. 12	Do. ...	Ditto.	Ditto.	3	28th October 1914	9th April 1915 to 10th April 1915.	24	9	58	29	24	9	58	29	Tillering not good, Less damage by lodging.
A	6	1	Punjab type, No. XI ...	Do. ...	Ditto.	Ditto.	3	27th October 1914 and 8th November 1914.	17th April 1915 ...	19	23	46	20	19	23	46	20	
A	7	1	Punjab type, No. XIV ...	Do. ...	Ditto.	Ditto.	3	Ditto.	21st April 1915 ... Average on 7 acres	18	11	53	19	18	11	53	19	
										...	...	...	...	20	15	56	8	

STATEMENT No. 5. — Showing the outturn of Gram grown on the Hansi Agricultural Station during Rabi 1915.

Block No.	Plot No.	Acres in acres.	Name of variety.	Previous crop.	TREATMENT.		Number of waterings given.	DATE OF		ACTUAL OUTTURN				OUTTURN PER ACRE				REMARKS.
					Before sowing.	After sowing.		Sowing.	Harvesting.	Grain.		Blasa.		Grain.		Blasa.		
										Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
B	1	1	Gram (local)	Jowar and Fallow.	Rajah plough = 2 Harrow = 3 Tops chopped with sickle.	1	29th - September 1914.	1st April 1915 ..	22	1	23	30	22	1	23	30	The crop suffered much through hailstorms in February and March.	
B	2	1	Ditto	Do.	Ditto.	1	Ditto.	1st April 1915 to 9th April 1915.	23	1	26	35	23	1	26	35		
B	3	1	Ditto	Do.	Ditto.	1	Ditto.	31st March 1915 to 9th April 1915.	22	15	33	28	22	15	33	28		
B	4	1	Ditto	Do.	Ditto.	1	Ditto.	11th April 1915 to 12th April 1915.	21	31	28	0	21	31	28	0		
B	5	1	Ditto	Do.	Ditto.	1	Ditto.	11th April 1915 ..	13	19	29	0	13	19	29	0		
B	6	1	Ditto	Do.	Ditto.	1	Ditto.	10th April 1915 to 11th April 1915.	16	24	26	10	16	24	26	10		
B	7	1	Ditto	Fallow ...	Ditto.	1	30th September 1914.	28th March 1915 to 12th April 1915.	21	33	27	30	21	33	27	30		
			(Late sown.)					Average on 7 acres	20	35								
B	8	1	Gram (local)	Fallow ...	Rajah plough = 3 Harrow = 5 Nil.	1	18th November 1914.	11th April 1915 to 12th April 1915.	11	22	19	30	11	22	19	30	Hail spoiled the crop in February and March. Also suffered through root rot. The land is mostly kallarathi.	
B	9	1	Ditto	Do. ...	Ditto.	1	Ditto.	12th April 1915 ...	8	2	9	5	8	2	9	5		
B	10	1	Ditto	Do. ...	Ditto.	1	Ditto.	Ditto.	6	7	7	30	6	7	7	30		

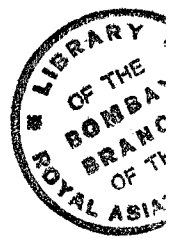
STATEMENT No. 6.—Showing the comparative results of Senji (*Melilotus Parviflora*) and Metha (*Trigonella faenum graecum*.)

No. of block and plot.	Area in acres.	Name of crop.	ACTUAL WEIGHT OF GREEN STUFF.		YIELD OF GREEN STUFF PER ACRE.		REMARKS.
			Maunds.	Seers.	Maunds.	Seers.	
A 8	13 — 24	Senji	149	3	275	8	Germination regular, crop good.
A 9	1	Metha	199	12	199	12	Ditto.
A 10	1	Metha	186	35	186	35	Ditto.

STATEMENT No. 7.—Showing the results of Japan rapes grown for fodder.

Name of crop.	Area in acres.	Cutting.	ACTUAL OUTTURN OF GREEN STUFF.		YIELD PER ACRE.		REMARKS.
			Maunds.	Seers.	Maunds.	Seers.	
White leaved ...	½	First ...	59	29	179	18	Germination thick. Crop good, but suffered from frost. If grown as vegetable it gives sweet sag.
		Second ...	59	4	118	8	
			148	33	297	26	
Black leaved ...	½	First ...	44	9	176	36	Germination thick. Crop fairly good, but suffered much from frost. If grown as vegetable, it gives more sweet sag than the other variety.
		Second ...	5	15	21	20	
			49	24	198	16	

**REPORT ON THE OPERATIONS OF THE
DEPARTMENT OF AGRICULTURE,
PUNJAB, FOR 1915-16.**



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REPORT

ON THE OPERATIONS OF THE

DEPARTMENT OF AGRICULTURE, PUNJAB,

FOR THE YEAR ENDING 30TH JUNE 1916



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*Proceedings of His Honour the Lieutenant-Governor of the Punjab, in the
Department of Revenue and Agriculture (Agriculture), No. 194,
dated the 18th November 1916.*

READ—

Letter No. 491—50-1, dated 12th October 1916, from the Senior Secretary to the Financial Commissioners, Punjab, forwarding, with a note by the Financial Commissioner, the Annual Report on the Operations of the Department of Agriculture in the Punjab for the year ending 30th June 1916.

REMARKS.—A third Assistant Director of Agriculture was added to the superior staff of the Department during the year, and the appointment of an Entomologist, for five years in the first instance, has been sanctioned by the Secretary of State, though the post is not to be filled until financial conditions improve. Meanwhile the Department is unquestionably short-handed, both in the superior and the subordinate staff. Mr. Southern's absence as a prisoner in the hands of the Turks is, His Honour hopes, only temporary, but the valuable practical results that the Department can already point to, have given a marked stimulus to the popular interest in scientific agriculture, and to meet the steadily increasing demands for research and demonstration work, a large expansion of the staff in the near future must be anticipated. Various proposals for increasing the efficiency of the Department are now under the consideration of Government, and the Lieutenant-Governor has already done what is possible under existing financial conditions to provide the necessary funds.

2. The year was one of satisfactory progress for the Agricultural College, which may now be considered to be well started on the road to success, and the curriculum has been wisely revised in accordance with experience of the past and to meet the needs of the future. The number of new admissions—40—was nearly double that of the previous year, though 16 students subsequently resigned and 2 had to be dismissed. Of the remaining 22 all but 2 passed the first year examination, while the whole of the second year class of 19 students was successful in the leaving certificate examination. The class of students admitted is said to have been superior to that of former years and earned the commendation of the outside examiner. The short vernacular course continues to prove successful, and 31 students were admitted as against 16 in the previous year: if the right type of men continue to be selected, *viz.*, men who come to the class with some practical knowledge of agriculture and return to their lands with the intention of putting into practice something at least of what they have learned at Lyallpur, they should prove very valuable as practical propagandists: the course is well supported by District Boards which now offer 32 scholarships for it besides 3 scholarships for the regular English course. It cannot be expected nor would it be desirable that all diplomates of the College should be provided for within the Department, and, as the Financial Commissioner observes, it is on the creation of a demand for experts by the landowners of the Province that the improvement of agriculture will largely depend. It is therefore encouraging to find that three graduates of the College have this year been employed by private landowners (Europeans) as managers of their estates, and it is hoped that the example which has been set will be followed by Indian landed proprietors.

3. Experiments in the reclamation of saline lands by steam ploughing, mole drains and plentiful washing with canal water have been in progress at Narwala for the last two years. Mr. Barnes has now established that such lands can be reclaimed at a cost of slightly over Rs. 18 an acre apart from the cost of water and of ditching operations, and a committee which met recently at Simla arrived at the conclusion that reclamation on a large scale could be effected at an outside cost of Rs. 50 per acre inclusive of all charges. With ordinary cultivation of the land reclaimed at Narwala Mr. Barnes succeeded

in obtaining a yield of wheat averaging over 22 maunds to the acre, though the land was originally the worst on the farm. The Lieutenant-Governor, with the Hon'ble Mr. Hill, had the opportunity of seeing personally the results of this experiment in April last, and he was much impressed not only by its success but by the eagerness of the adjoining *zamindars* that it should be extended to their saline lands. The success of the methods employed has been amply demonstrated, and a project is now being worked out for the reclamation on similar lines of Government lands in the Lower Bari Doab colony, where it is hoped that very large areas of *kallarathi* land, worth only Rs. 50 per acre and at present unfit for distribution to colonists, can be converted into first class land worth up to Rs. 300 per acre. In other directions also valuable work is being done by the Agricultural Chemist: the investigation of problems connected with the rise of the spring level in the Lower Chenab colony promises to have important results, while experiments with sugar-beet seed have demonstrated the possibility of raising beet with a high percentage of sucrose in Kashmir and even at Lyallpur, and point to the establishment of a beet sugar industry as a possible development. The Lieutenant-Governor is inclined to agree with the Director that there is no reason to think that other crops will oust sugarcane in the North Punjab, and even if the conditions are not suitable for the production of refined sugar—a conclusion which he still hesitates to accept,—the manufacture of gur is not likely to be less profitable in the future than in the past.

4. The work of Mr. Milne, the Economic Botanist, in separating and selecting different types of wheat and cotton continues on the lines which have been so successful in the past: in addition the isolation of types of barley and gram has been commenced. Barley in particular merits careful attention, as there is reason to anticipate a considerable demand for this grain for export for malting purposes. The varietal tests conducted by the Professor of Agriculture at Lyallpur and by the Deputy Director at Gurdaspur have served chiefly to confirm previous conclusions as to the most suitable varieties of wheat and cotton, conclusions which are endorsed by the ever-growing popularity of 4-F American cotton and of Punjab 11 and Pusa 12 wheat. The progress made with this acclimatised cotton is indeed astonishing, and in the present year it is estimated that an area of 50,000 acres has been sown with it as compared with 7,700 acres in 1915. As this cotton sells at a premium of from Rs. 2-8-0 to Rs. 4 per maund over country cotton, the additional profits reaped by cultivators are very considerable. Similarly, the area of wheat grown from the Department's selected seed rose from about 8,500 acres to nearly 30,000 acres. The propagation of these varieties of wheat and cotton—the superiority of which is now generally recognised—all over the Province is only limited by the difficulties in providing pure seed in sufficient quantities to meet the demand and expert establishment to advise the cultivators, and Government will be glad to provide all reasonable assistance to the Department in furtherance of those objects. The sphere of the Department's activities in this educative work is gradually widening, and two new districts, Rohtak and Amritsar, are now being worked. The need for enlarging the staff to cope with this increase of work is fully recognised by Government, and seven extra *mugaddams* were sanctioned during the year for district demonstration, while an addition of four to the cadre of Agricultural Assistants has also recently been agreed to. The hydraulic experiments instituted by the Professor of Agriculture on the lines suggested by the Imperial Botanist are as yet only in their infancy, but the results already attained are sufficient to show how valuable the investigation may prove in demonstrating that the finest yields of wheat can be secured by careful cultivation with the minimum of irrigation. The trial of Scotch potatoes in the Simla Hills has proved an unqualified success, and affords one more proof of the direct material benefits conferred on cultivators by the efforts of the Department.

5. The attention of the Agricultural Engineer has again been devoted chiefly to well-boring operations, and both the amount of work accomplished and the percentage of success obtained mark an improvement on the previous year. Three tube-well installations worked by mechanical power have been completed and a large number of estimates for similar installations have

been prepared for private individuals. Mr. Brownlie is also doing useful work in designing improved agricultural implements of a simple and inexpensive type to take the place of the primitive tools in ordinary use.

6. The work of the Department in spreading through the Province a knowledge of the results obtained by the investigations of its experts, in demonstrating the value of improved methods and instruments of agriculture and popularizing the use of selected seed is rightly regarded by the Director as of paramount importance. In this work valuable assistance can be rendered by the district agricultural associations of which two more were formed during the year in Shahpur and Hissar. Of even more value are the demonstration farms started by the Sialkot and Amritsar District Boards from which the Director anticipates most satisfactory results. A similar farm is contemplated by the Gujrat District Board, and the example is one which His Honour hopes will be followed by many other boards. Reference has already been made to the success which has been obtained with selected wheat and cotton seed: equally encouraging is the very considerable increase in the sales of improved instruments in a year when prices were high. In this connection His Honour is pleased to note the use which is being made of co-operative banks as sub-agents of the firm which supplies Meston ploughs and the assistance which is being given by them in the distribution of selected seed.

7. His Honour learns with satisfaction of the cordial co-operation of the Irrigation Department in the *rek* reclamation experiments to which reference has been made above, in the distribution of selected seed in the Lower Bari Doab colony and in the very interesting and important water-saving experiments that are being conducted in Lyallpur, Montgomery and Sargodha. Orders have been issued for the reservation of at least two posts of Canal Zilladar every year for graduates of the Agricultural College.

8. In spite of the war and of the restrictions which it has been necessary to place upon new expenditure, the year has been one of real progress upon which His Honour desires to congratulate all the officers of the Department. It is now in close touch with the leading agriculturists of the Canal colonies and of the central districts, and finds much scope for its activities in the development of the large areas allotted recently on the Lower Bari Doab Canal for agricultural objects, dairy farming, cattle-breeding, &c. Its further expansion in all districts of the Province is only a question of time, and should be steadily promoted through the agency of the Department assisted by local agricultural societies and District Boards. The acknowledgments of Government are due to Mr. Townsend for the steady progress achieved and for the tact and zeal with which he has supervised the Department during the year. The Lieutenant-Governor also desires to put on record his appreciation of the valuable work—both scientific and practical—done by Messrs. Barnes, Roberts and Milne in their respective branches.

* ORDER.—Ordered that a copy of these remarks be forwarded to the Senior Secretary to the Financial Commissioners, Punjab, for the information of the Financial Commissioners, that they be published in the *Punjab Gazette* and submitted with copies of the report to the Government of India in the Department of Revenue and Agriculture.

By order of His Honour the Lieutenant-Governor of the Punjab,

H. D. CRAIK,

Revenue Secretary to Government, Punjab.

No. 491—50-1.

FINANCIAL COMMISSIONERS' OFFICE :

Dated Lahore, 12th October 1916.

FROM

MILES IRVING, ESQUIRE, I.C.S.,
*Senior Secretary to the Financial Commissioners,
Punjab,*

TO

THE HON'BLE MR. H. D. CRAIK, I.C.S.,
Revenue Secretary to Government, Punjab.

The Hon'ble Mr. H. J. Maynard, C.S.I., I.C.S.

SIR,

I AM directed to submit the Annual Report of the Department of Agriculture with a note by the Financial Commissioner and to express regret that owing to its receipt in this office somewhat after the proper time it has not been possible to let Government have it by the due date.

2. With reference to your letter No. 14 (Rev.), dated 20th January 1916, the Director of Agriculture regrets that the press at Roorkee have found it impossible, presumably owing to press of war work, to complete in sufficient time for incorporation in his Annual Report the map referred to. He will take steps to see the map is included in next year's report.

I have the honour to be,

SIR,

Your most obedient servant,

MILES IRVING,
Senior Secretary to the Financial Commissioners, Punjab.

NOTE.

THE tide in the affairs of the Agricultural College noticed in last year's report continues to flow favourably. There were as there stated no students at all in 1913 and the case of the College looked very black. In 1914 a class of 23 was opened of whom 19 persevered to form the second year class of 1915 and passed the Leaving Certificate Examination, and 40 fresh men have entered. The commendatory remarks made by the outside examiner, Mr. Evans, on the work of the College students were a well deserved gratification to Mr. Barnes and the staff of the College.

2. Not only must the ultimate future of the College depend on the demand for the services of its graduates made outside the Government services, but it is on the creation of a demand for experts by the land-owners of the province that the improvement of agriculture in the Punjab largely turns. It is therefore satisfactory to see that three land-owners have been supplied with agents from the College. It would be well if the example of these land-owners who are all Europeans were followed by Indian landlords, and the Financial Commissioner is arranging to set an example in the case of estates under the Court of Wards. The matter is one which should be brought to the notice of the district agricultural associations some of which include owners of substantial estates. It is equally important that those who are to be the owners of estates should receive education in their management. The Financial Commissioner believes that absence of proper living accommodation has deterred students of the Aitchison College from proceeding to a course of instruction at Lyallpur, and is making proposals to remedy this defect.

3. Mr. Barnes' experiments in *reh* reclamation at Narwala have reached the point where they can be translated into practice. A committee which met at Ellerslie in September to consider his report was of opinion that his methods could be profitably applied to the reclamation of a large area on the Lower Bari Doab with the prospect that land now worth Rs. 50 per acre could with an additional expenditure of certainly not more than Rs. 50 be turned into first class land worth as much as Rs. 300. Mr. Barnes has now been asked to draw up, with the assistance of an officer of the Irrigation Branch, a working project for reclamation on the Lower Bari Doab. The total area of bad and inferior land there is over 300,000 acres, of which a substantial fraction is affected by the excess of saline matter.

The investigation into problems connected with the rise of the spring level in the Lower Chenab Canal Colony seems likely to lead to conclusions of far reaching significance : but is still incomplete.

4. The work of scientific research in the Departments of Botany and Entomology has produced some interesting and important results. Among these is the unsuitability of sandy soils for the growth of American cottons, not merely because the crop is poor but because the lint grown on such land if mixed with the produce of better lands impairs the regularity of length and strength of the fibres of the whole consignment. The report on the value of American cottons made by Messrs. Tata & Company shows that cotton can be grown in the Punjab worth as much as Rs. 500 per candy of 784 pounds. It is worth note that American cottons remained free from boll-worm while country cottons suffered considerably. The date palms of the South-Western Punjab and the Scotch potatoes of the Simla hills are additions to the wealth of the country which promise well. Progress has been made in sericulture, and the Financial Commissioner was greatly interested in what he saw at the Salvation Army School at Simla. A very large number of mulberry trees have been planted, arrangements have been made for rearing in the school on a considerable scale, and all operations except dyeing are conducted there. This industry which

he understands brought to the Kashmir State last season a revenue of 20 lakhs is well worth support by the Chiefs of the Simla Hill States. Some of the Chiefs likely to be interested might be invited to visit the school. The report of the Assistant Professor of Entomology shows the importance of the expert examination of consignments of seed, to ascertain that it is not affected by pebrine.

5. In spite of the high prices of tools and plant and the difficulty of obtaining supplies from Europe, good results have been exhibited by Mr. Brownlie both in the number of well borings and in the percentage of success, and the Financial Commissioner is interested to note that two tube well installations to irrigate over 300 acres each have been completed for private owners. The Financial Commissioner has recommended proposals for increasing the workshop for experimental and repair purposes and procuring deep boring plant. Measures such as these for adding directly to the wealth of the country are not such as it is wisdom to postpone for considerations of financial stringency.

6. As the result of 3 years' experiments it has been possible to arrive at the important conclusion that in Punjab No. 11 we have the best type of wheat that we can offer to the cultivators to grow. In cottons the tests are still inconclusive, but the choice seems to lie between two varieties of American cotton. Mr. Conville, an expert in cotton, is very well satisfied with 4 F. The water saving experiments are interesting and important; they are being conducted in consultation with the Irrigation Branch. Not only in this case, in which the Canal authorities have a direct interest of their own, but also in many others, such as the reclamation of salt lands and the orders that a minimum of two appointments to the post of Zilladar are to be given annually to diplomates of the Agricultural College, the Financial Commissioner desires to acknowledge the cordial co-operation of the Canal authorities. In addition to experimental and demonstration farms maintained by Government, demonstration farms are kept up by the district boards of Sialkot and Amritsar and by the estates of Mamdot and Guru Har Sahai under the Court of Wards. To give their full value to these farms there must, as noted by the Officiating Deputy Director at Gurdaspur, be provided suitable accommodation for visitors. It has been suggested to the Commissioner of Lahore that the district boards of adjoining districts should send deputations to see the Sialkot and Amritsar farms. These examples are well worthy of imitation by such boards and estates as can afford it: but additions to the number of demonstration farms are dependent upon additions to the cadre of Agricultural Assistants for whom such of the district boards as have any surplus means may very reasonably be expected to pay as soon as the College can train a sufficient number of the men. The unsatisfactory management of all municipal sewage farms except that at Amritsar has been recently brought to notice by the Sanitary Engineer, and the question whether these farms can in any cases be combined with demonstration farms is under consideration.

7. The sale of instruments has in spite of difficulties due to the war shown a considerable increase, and the Financial Commissioner attaches great importance to the attempts to introduce more simple instruments which though not so efficient as foreign made implements are cheaper and easier to repair and are improvements on the local makes. A great deal of pains and ingenuity are being bestowed upon these at Lyallpur. Akin to these are the imitations of meston ploughs turned out by village blacksmiths in the Central Punjab. It is understood that these imitations involve the violation of no patents. For the mass of agriculturists for many years cheapness and simplicity are merely particular phases of efficiency. The progress made in the introduction of American cotton is most satisfactory. Over 7,000 maunds of type 4 F. were sold by auction in the Chenab and Jhelum colonies at a premium over the price for country cotton varying from Rs. 2-8-0 to Rs. 4-0-0 and 50,000 acres were placed under this cotton as compared with 7,700 last year. It is understood that something like three lakhs of rupees

were added in a single season to the incomes of cultivators in the Lower Chenab Canal Colony alone by this substitution. 4 F cotton was one of the selections made by Mr. Milne, the Economic Botanist, and the popularisation of this variety by the Agricultural Department on his recommendation is a most gratifying indication of the results to be secured by cordial co-operation between the Botanist and Agriculturist. There is no reason why this progress should stop until American replaces country cotton wherever the soil and other conditions are suitable and this opens endless scope for the activities of the department. It is not enough to sell good seed to whoever will buy: if the carelessness or cupidity of growers or buyers causes seed to be mixed the labour is but lost, and the maintenance of the quality of the Punjab cotton crop will always demand unremitting care on the part of an ample staff of trained supervisors.

8. The Agricultural Department is not a commercial department in financial parlance; it gets no book credit for the additional land revenue which its operations earn; and it is therefore the more important to remember in considering the proposals that will be submitted during the coming years for increase of expenditure on it, that such expenditure is immediately or ultimately as productive as any in the budget of the Government of India.

9. What has been said of cotton applies also to wheat. As against 8,500 acres of selected wheats last year we have 30,000, chiefly under Punjab 11, which, as also Pusa 12, yields about a maund an acre more than the country wheat it replaces. If the share of Government in the gross produce be taken at one-twelfth, every acre means between 4 and 5 annas to Government at the next revision of assessment.

10. The Financial Commissioner is glad to see that the Co-operative Credit Societies are helping in the distribution and stocking of seed, and that they are becoming agents for the sale of improved implements.

11. The needs of the Pusa Institute are, it is understood, likely to deprive the province within a short period of the valued services of Mr. Barnes, the Principal of the College and the Agriculturist Chemist. Since research and instruction are combined in his work, this loss will affect both the interests of agricultural education and those of agricultural investigation. It is of grave moment to the welfare of the province, if it must lose Mr. Barnes, that he should be replaced by a successor fitted to continue in a worthy manner both sides of his work. Though Mr. Barnes, if translated elsewhere, will, it is hoped, be able to follow up certain special investigations in the Punjab, his chemical work, both education and research, cannot be handed over to an Assistant Professor without very serious loss to both, such as no purely educational institution would suffer by being deprived of an instructor.

12. Mr. Townsend's story of the converted opponent at Jullundur who has now taken to improved ploughs and selected seed is very inspiring. The Agricultural Department has already won, and, still more, has yet before it, triumphs of a kind which do not fall to the ordinary administrator: the triumphs of persuasion and conviction. In conclusion the Financial Commissioner congratulates the department and Mr. Townsend on a year of excellent progress under somewhat adverse conditions due to the war. Mr. Townsend has supervised the department with zeal and discretion and has submitted an interesting report. In Mr. Southern, reported missing in Mesopotamia, the department has lost a valuable officer, but hopes for his return on release from captivity.

H. J. MAYNARD,
Financial Commissioner, Punjab.

ANNUAL REPORT
OF THE
DEPARTMENT OF AGRICULTURE, PUNJAB,
FOR THE YEAR ENDING 30TH JUNE 1916.

1. There are but few matters to report as to the staff during the year. I held the post of Director of Agriculture throughout the year. Mr. Southern, Deputy Director of Agriculture, who had gone to the Indian Army Reserve of Officers, has unfortunately been reported "missing" in Mesopotamia. It is hoped that we will soon hear good news of him. Mr. Roberts, Professor of Agriculture, has gone on seven months' leave, during three of which he is being deputed to study cotton in America; the increasing importance of American cotton in this province renders it advisable that one of our officers should have a first hand knowledge of the crop as grown in its own country. A third Assistant Director was appointed last spring; the post was filled by M. Muhammad Abdullah, who has long been doing good work as Manager of the Lyallpur Farm. He will remain posted to Lyallpur, under the Professor of Agriculture; the expanding district work there will give him much occupation. The Secretary of State has sanctioned, for five years in the first place, the appointment of an Entomologist to this province; he will not, however, take any steps to actually fill the appointment till financial conditions materially improve.

2. Full details are given in Appendix I, which is the Principal's report. The demand for admission both to the English and Vernacular classes—both of which were, on opening, completely full—was very satisfactory, and showed that the College is at last beginning to be appreciated at its proper worth.

There was no third year's class in the year under report, as there was no first year class in 1913. Many district boards are now giving scholarships for both the ordinary and vernacular classes, particularly the latter. I am glad to note that a demand is springing up among private land owners for diplomates of the College as managers of their estates. Three applications were received during the year for men suitable for these posts, and all were complied with. I must, however, admit that all these applications were from Europeans. It is to be hoped that the large Indian land owners of the province, including the capitalist owners of large areas in the colonies, will soon realize that diplomates of the College are more likely to make good managers of their estates than are the present munshis—not infrequently dismissed patwaris or kanungos—whom they now employ.

The Chief Engineer, Irrigation, has—see paragraph 3 of last year's report—now officially issued orders that a minimum of two appointments to Zilladarships a year are to be given to diplomates of the College.

Kartar Singh, the Research student mentioned in the Principal's report, has recently been given a post by me in the department. He will be in charge of the dairy attached to the farm at Lyallpur—a post to which he should be well fitted, as the subject for which he was given his research scholarship was dairying, which he studied in many parts of India. He appears to have made good use of his time. Posts have also been recently given to three successful students who passed the Leaving Certificate Examination (two years' course), but did not go on to the second part of the course.

The external examiner who came to the College last spring to examine the second year class in agriculture was Mr. Evans, Deputy Director of Agriculture in the Central Provinces; he told me that "he was quite favourably impressed with the men he examined in agriculture."

A proposal to affiliate the College to the Punjab University is now under consideration.

3. Full details are found in Appendix II. Far the most interesting of the various investigations pursued by Mr. Barnes during the year was the reclamation experiment at Narwala, which is now approaching a successful conclusion. Mr. Barnes has shown in his separate printed note, which gives the financial results of those operations in detail, that for a sum of about Rs. 18 per acre, plus a charge as yet undecided for additional water, it should be possible to reclaim ordinary *kallar* land in the province. The charge indeed may eventually be a little less if it be found unnecessary to drain the land to be treated, and the only operations required are deep cultivation and washing. The note in question, the inclusion of which would add unduly to the length of this report, is already with Government, and should be studied in order to thoroughly appreciate this most interesting experiment. The only uncertain point in it is how long the land reclaimed will remain in that condition. As to this experience alone can decide: Mr. Barnes, however, thinks that it will remain in its reclaimed condition for a considerable number of years if properly cultivated.

Mr. Barnes takes, it will be seen, a gloomy view of the prospects of sugarcane improvements, at any rate in the Punjab proper. It may be, as he says, that sugarcane will eventually give way to other crops. Personally, however, I think this improbable. The Punjab canes may—indeed do—give less profit than those of Southern India. But even so, so profitable is the crop, the zamindar finds its cultivation pays him better than would other crops.

4. Full details as to the botanical work done will be found in Appendix III. As the area at the disposal of Mr. Milne, the Botanist, at Lyallpur, did not appear to be sufficient for his needs, I have arranged to give him another square of 25 acres out of the additional area that has been surrendered by the municipality to the farm. I have also removed the restriction on him that formerly existed, of not being allowed to grow any one variety of a crop on a larger area than half an acre—the Professor of Agriculture or Deputy Directors of Agriculture being asked to undertake any tests on a larger scale that were necessary. Such restriction I found had been imposed on no other botanist in India. Mr. Milne is now at liberty to grow any crops he likes up to any area he likes, in the land at his disposal. Tests, on a larger scale than the land he has permits, have of course still to be made by the agricultural officers, with whom rests the decision as to what varieties should be definitely given to zamindars for trial.

The date palms the department has been growing in the south-west of the province continue to show very successful results: the contrast between the dates they produce and the country fruit being most marked, both in appearance and price. The District Board at Muzaffargarh is meditating putting a considerably larger area under these dates. There is a large outside demand for suckers, which we cannot satisfy.

5. See Appendix IV. The cotton-bollworm attack, though not very bad, was rather worse than usual on account of the drought, especially near Sargodha. Country cottons were more affected than American. The usual measures to breed the bollworm parasite were taken. This year I am entrusting the distribution of these parasite boxes to the agricultural staff in some districts. Hitherto it has been done, but not satisfactorily, by the revenue staff.

6. Figures are given in Appendix IV. The amount of seed distributed was much as last year—400 ounces through Sheikh Ghulam Sadiq of Amritsar, and 175 ounces direct to cultivators. I have little to add to what I said on the subject last year. The seed we got from France was not so good as usual, so the results were below average.

The work in schools mentioned in paragraph 7 of the last year's report continues, and, despite Mr. Lefroy's condemnation, I think it is a not an unhopeful line of work. In this connection I may note that last year opposition to sericulture was raised by every school in the Kharar and Rupar Tahsils of Ambala in which we tried it. So great was the opposition I asked the Deputy Commissioner to specially enquire into the reason. The "fons et origo mali" was found to be an Assistant Inspector of Schools, who disliked sericulture, and made all the schools under him object to it. He was transferred: and the schools in question are now quite keen on their silk-worms.

The Salvation Army Silk School at Simla was open for only a short time at the close of the year under report. It gets a grant from Government, in return for which I can nominate a certain number of students to free tuition at it. I had no difficulty in finding students wishing to take these nominations. So far the school seems to be making a satisfactory start, but I think the Salvation Army would be well advised to try to interest the rulers of the Hill States around Simla in it. More detailed mention of the school will come in next year's report.

Mr. Lefroy who is investigating the silk industry in India for the Government of India told me he has written a special section in his report on the Punjab, which contains certain recommendations. I am awaiting the report in question to see if we can take action on these recommendations.

7. During the year Mr. Cousins delivered 18 lectures with demonstrations to different parties who visited his apiary at Sanawar on various occasions. Lectures were also given to classes of school children: these resulted in the institution of an educational apiary in the girls' school in the Lawrence Military Asylum. Neighbouring villages were also visited and advice and instruction given.

Apiculture.

The bees introduced into Najibabad last year are doing well.

The apiary was freely used for experiments, mainly to test the suitability or otherwise of English, Indian and Ceylon made comb foundation, and useful results have been obtained. Owing to the absence of winter rains and the abnormally dry spring, remarkably few swarms took place, and increase of stock, either by natural or artificial swarming, was almost impossible.

Letters from all over India were received and about 180 letters regarding apiculture were answered. Correspondence will be lighter when the "Guide to Bee Keeping" by Mr. Cousins—which is now in the press—is published.

The apiary was visited by me. It was also visited by Mr. R. R. Awati, B.A., F.E.S., Entomologist to the Indian Research Fund Association, accompanied by Dr. V. T. Korke, Assistant Director, Central Research Institute, Kasauli, Mr. Dance, a member of the Hants Bee Keepers' Association, and Captain and Mrs. Sheard of the Salvation Army; all approved of the apicultural methods adopted there.

There are now 36 members of the Simla Bee Keepers' Association: several of the Hill Chiefs have joined the Association. Mr. Cousins is now making a tour through some of the Hill States to preach his apicultural methods.

His appointment has been extended for two years, and it is hoped by the end of this period—if the intervening seasons are propitious—that apiculture on modern lines will be more or less an established industry in the hill districts.

8. Full details of the work done by Mr. Brownlie, the Agricultural Engineer, will be found in Appendix V. It will be seen that, with a staff of the same size, he has succeeded in raising the number of well borings completed in the year to 346 from 237 in the previous year, and the percentage of success obtained from 59½ to nearly 69. The use of strainers at the end of the plain pipes, which Mr. Brownlie mentions, should considerably increase the proportion of successful boring. But daily increasing difficulty is being experienced in getting the materials required by Mr. Brownlie from England: which are also daily increasing in price. I have recently taken steps to keep the well borers more

Agricultural Engineering.

in touch with Assistant Directors and Agricultural Assistants. The three tube well installations worked by mechanical power which were completed during the year by Mr. Brownlie are all successful, and, judging from the number of applications for estimates for similar installations we have received, will be widely imitated. Much more work could be undertaken with a larger staff. That we will probably soon obtain: but it must be remembered that Mr. Brownlie has to supervise all the work in progress, and, as he cannot supervise an unlimited amount, we must not undertake too much.

I have recently submitted proposals to considerably increase the workshop facilities at his disposal, and have asked for funds next year for the purchase of the deep boring plants he asks for. Without them it is impossible to tap the artesian supplies, which, Mr. Brownlie is confident, exist in parts of the province.

9. *Wheat*.—In this and the two following paragraphs I briefly summarise the results gained at our two principal experimental farms, Lyallpur and Gurdaspur. *Agricultural research and experiment.* Hansi farm is not yet sufficiently out of the initial stage, nor is the land there as yet sufficiently even in quality, to warrant as much weight being attached to the results obtained there as to those at the other two farms.

Full particulars will be found in Appendices VI and VII, which describe in detail all the experiments carried out at each farm separately. It will be convenient however here to discuss separately the wheat and cotton work, as regards varietal tests, being the most important crops of the province, at both farms together. Paragraph 11 discusses briefly the other experiments in progress.

As to wheat. The season was not on the whole unfavourable. The winter rains were, it is true, in considerable defect: but though the fodder was very short, and some barani crops very poor, the crop was free from rust or disease, save to some extent at Gurdaspur, and the grain well filled. At Lyallpur the wheats tested are all grown irrigated: at Gurdaspur nearly all are unirrigated. At the former place (Appendix VI) the varietal tests between Punjab types 11 and 17, our most successful wheats so far (we are pushing Punjab 11 in the colonies), and the well known Pusa 12 wheat are very interesting. It will be seen that the results of three years are collated: and Mr. Faulkner comes to the conclusion, in which he agrees with Mr. Roberts, that Punjab 11 is the best wheat we can offer to zamindars to grow at present. The words "to zamindars to grow" are important: as under our direct cultivation Pusa 12 gave better comparative results than it did when grown by our tenants. The matter is of course of vital importance in this province, and is receiving the attention it deserves.

At Gurdaspur (Appendix VII) our barani wheats were very much better than those in the surrounding zamindars' area, and this was remarked on by all visitors to the farm. With practically no winter rains as we had last year, the better cultivation our land got was eminently successful in producing better crops. Pusa 4 and Pusa 12 wheats were tried against local wheats (see Statement 7 in that Appendix). It will be seen that the local wheats generally did best: but it was a hard year on the Pusa wheats which needed more moisture than they got. The experiments will continue.

It will be seen that at both farms tests are being made with wheats handed over by the Economic Botanist.

10. *Cotton*.—No work in cotton is done at Gurdaspur: though a very small area is devoted there to environment tests of cottons for the Economic Botanist.

At Lyallpur the most interesting experiments are those shown in Statement 14 of Appendix VI, of various American and country cottons which have been handed over by the Economic Botanist to the agricultural section for testing on a field scale. Mr. Faulkner, the Professor of Agriculture, it will be seen, does not wish to comment on the results arrived at so far. Doubtless the

tests must be further continued. So far as they go they seem to show that American cotton No. 266-F is but little inferior to 4-F, which alone we are pushing outside, and that among country cottons the yield given by *Gossypium neglectum rosea* No 87 is considerably in excess of that given by other varieties.

11. *General.*—Appendices VI and VII contain many other interesting experiments. Among the most notable I may mention the water-saving experiments (Statements 16 A and B of Appendix VI) at Lyallpur, which are being conducted in consultation with the Irrigation Department. It will be sometime before these give results: but nobody will deny that they are of the first importance to the province. I am also having experiments made in water-saving at Montgomery, Sargodha and Gangapur (in the Chenab colony). The lines of the experiment have been laid down by Mr. Howard, Imperial Botanist, who knows the Chenab colony well, and has been very successful—*vide* his recent bulletin on the subject—in water-saving experiments in Baluchistan. And though of course Baluchistan differs much from the Punjab in climate, I am sure his experience there must have helped him considerably in laying down the lines of experiment for us in this province. Some selected Canes are now being given out in the neighbourhood of Gurdaspur for trial. I am having a new series of experiments laid down both at Lyallpur and Gurdaspur to test more fully the action of bones, whether as bone meal or superphosphate, as manure.

12. It will not, perhaps, be out of place to mention here that proposals to increase the areas at the disposal of the department at Lyallpur or Gurdaspur have either recently been given effect to (this at Lyallpur) or have been submitted to Government (this at Gurdaspur). Experience has shown that so much of the existing farm areas are given up to manurial or cultural experiments in various crops, the majority of which must of necessity last for some years, that there is not sufficient room for the, to my mind even more important, varietal experiments between different kinds of wheat and cotton. At Gurdaspur in particular, which was started originally as a sugarcane farm, with wheat as a “side show,” if I may be excused the term, but where it has gradually ousted sugarcane—in which crop it is hard to do much good at Gurdaspur, with its cold winter—the land available for varietal experiments in wheat was insufficient. But it is of the first importance to ascertain what barani wheats are best adapted to the Central Punjab, and this can only be ascertained by varietal experiments: which—in their turn—can only be made at Gurdaspur. In these additional areas only varietal tests of wheat and cotton, in, of course their usual rotations, will be made: and more of the varieties of these crops which the Economic Botanist wishes tried on a field scale by the agriculturists will be tried by them, than has been possible in the past.

13. Full details are given in Appendix VIII. The area that will be under direct cultivation has now all been broken up and levelled. That area which will go under tenants is also nearly all ready for them, but no tenants are procurable, owing to the distance of the farm from the nearest village, till houses are erected for them, and for that they must wait for the present.

This is primarily a cotton farm, and S. Darshan Singh has initiated many interesting experiments both in this and other crops. It would be unsafe however to draw as yet any inferences from the results of the experiments so far available. In any case they have not continued long enough: apart from that the year was an exceptional one owing to the failure of the monsoon, and the quality of the soil on the farm is very uneven. It will doubtless gradually become more uniform, owing to good cultivation, but this will take time.

The problem of a good *desi* cotton is important here. American cotton should be sown in April; but in Hariana cotton generally follows wheat, and this crop is not off the ground in time for that cultivation, etc., of the land which is necessary if a good crop of American cotton is to be obtained. So we must look for a variety to be sown later, and it probably must be *desi*. It is

therefore well that the Deputy Director has devoted considerable attention to the question of ascertaining which of the separate constituents of the local Bhatla variety is the best. It is the highest yielder in the neighbourhood ; but is itself a mixture of four different types

I have directed that some experiments under barani conditions also should be instituted. The land is available and the experiments may give us useful results. But they of course yield in importance to those on irrigated land. I am also trying to find a perennial drought resisting fodder grass, to be grown without irrigation. Hopes of success in this are very faint, but the experiment is well worth trying, as, if successful, it would confer much benefit on the whole of the South Eastern Punjab.

14. In this paragraph I wish to mention the smaller farms run by the department, as distinct from the larger farms at Lyallpur, Gurdaspur and Hansi. I give a brief account of each of them. Sargodha is practically altogether a demonstration and seed farm, experiments being conducted only rarely. It is nearly altogether given up to the growing of 4-F American cotton and Punjab 11 wheat, the demand for the seed of which crops is very great in the Jhelum colony. Hitherto only 14 acres have been under our direct cultivation, the balance of the estate, some 130 acres, being cultivated by tenants. I am however adding 25 acres from the area now cultivated by tenants, to that under our direct cultivation, as it is essential to increase the area at the disposal of the department in the province as a whole available for the testing of the different varieties of wheat and cotton offering themselves. Tenants cannot do this properly.

The farm is now getting well known all through the colony, and is much resorted to by zamindars in search of seed, implements and advice.

Basal is a small demonstration farm of 20 acres in the Attock District. It is principally meant to show dry farming methods for wheat growing. It is gradually exciting interest in the neighbourhood : as a result of visits to the farm 13 rajah ploughs and 2 harrows were sold in the district last year.

Guruharsahai and Jallalabad are useful seed and demonstration farms in the Perozepore District. They are both under the Court of Wards.

At Harsahana in the Rohtak District the D. D. A., Hansi, took 10 acres of land badly infested with deep-rooted grasses, which had been, on account of them, lying uncultivated for over 50 years. The owner could make no use of, or get any rent for, the land. The D. D. A. sent a rajah plough and a harrow there with the necessary staff. The land was all broken up, two ploughings and two harrowings being given to it all. As a result it has now been rented at Rs. 6 an acre, and bears good crops. As a result of this good piece of work 19 rajah ploughs were sold in the neighbourhood.

The Badiana farm in Sialkot, mentioned in paragraph 16 of last year's report, is now entirely under the management of the agricultural department, though financed by the district board. This board has obtained the services of a competent agricultural assistant from us on deputation : he is in charge of the farm and of the work of agricultural improvements generally in the district. He has only very recently assumed charge of his duties, but the results of the scheme will, I am sure, be very satisfactory, and the Sialkot district board are to be complimented on the action it took in this matter, without, I understand, the least official pressure being applied to it. Gujrat district board is sending up proposals to acquire land for such a farm : Amritsar has started one at Beas, and will shortly start another at Ajnala. It is hoped that the Gujrat and Amritsar district boards, while heartily to be congratulated on the action they have taken, will carry these projects to their logical conclusion, and employ agricultural assistants to supervise these farms. I will do my best to send them good men. It is impossible for Government, especially in these days of financial stringency, at present to post and pay agricultural assistants in all districts of the province.

It is hoped that the project to start a farm which the district board of Rohtak is nibbling at, under the advice of the Hon'ble Mr. Lal Chand, will mature.

Possession was recently taken by us of the ten squares (250 acres) at Montgomery reserved for the agricultural department, which had formerly been on temporary cultivation. The land is all being cultivated by tenants, and will be used as a demonstration and seed farm: it should be particularly useful as a source of absolutely pure 4-F cotton seed.

The Financial Commissioner recently agreed to reserve for us a somewhat similar area in the Chilianwala Bar (Gujrat District) now coming under colonization: it will be most important to have a good seed farm there.

15. The Lower Bari Doab colony differs, so far as the agricultural department is concerned, from the other colonies of the province, in that various fairly large grants of land have been made in it for purposes, either purely agricultural, or connected with agriculture. Among the first are Mr. Conville's cotton grant and S. Jogendra Singh's steam ploughing grant: among the second are the four cattle-breeding grants, which were mentioned in the Civil Veterinary Department Report; and, though less immediately connected with agriculture, there are also Captain Vanrenen's and Colonel Cole's horse-breeding grants, and the large oat-hay farm near Okara. The last farm is managed by Mr. Flowerdew, who takes much interest in agriculture, and both he and Captain Vanrenen keep in close touch with the department: and are always ready to help in every way. Captain Vanrenen has an *ex-student* of the College as his farm manager; so has Mr. Conville. Of the 3,000 acres granted to Mr. Conville 2,700 have been cleared: and 1,007 acres were under 4-F American cotton last kharif, the average yield being 9 maunds per acre: of the resulting seed the Department purchased 100 maunds for distribution in the colony. The Irrigation Officers of the third Division, Lower Bari Doab Canal, gave, I should note, great assistance in this distribution. Last rabi 1,018 acres were under wheat, all Punjab 11. For next rabi Mr. Conville is storing 2,200 maunds of wheat for sowing, and a demand for it is already showing itself. A seed godown on a plan drawn up by Mr. Brownlie is being erected on the farm, and it is greatly to be hoped this will be successful against weevil attacks, as it would then be a most useful object lesson.

It is satisfactory to find that Mr. Conville, an expert in cotton, is very enthusiastic about our American 4-F cotton, and does not intend to let any other cotton be sown on his estate in future. He is also pleased with the Punjab 11 wheat we are pushing.

The district board has established a school on his farm, where an endeavour is being made to get the children interested in agriculture.

S. Jogendra Singh's grant of 2,000 acres is for steam cultivation. Some 400 acres still remain to be broken up. Some 330 acres were under wheat last spring, nearly all Punjab 11, and 230 acres are now under cotton, all 4-F. The Sirdar is very pleased with his steam-tackle, and has shown that for large and compact estates in the colonies it will pay. It would not, I think, pay to break up in this way small parcels of land scattered over the colony at long distances from each other.

As to the area of 7,500 acres reserved for growing American cotton in the Lower Bari Doab colony, mention of which was made in the concluding portion of paragraph 13 of last year's report, the British Cotton Growing Association, than which it is impossible to find a more powerful body, though it originally refused to have anything to do with the scheme, has recently written to me again on the subject, and is apparently prepared to reconsider that refusal. I sincerely trust it will be possible to come to terms with them. I am now in correspondence with them on the subject.

16. Mr. F. J. Mitchell, who is in charge of the olive cultivation in the Salt Range—the department has nothing to do with it—sends the following note as regards them:—

Olives. "Progress at Ganlalla garden was most disappointing. Little or no growth was apparent since the previous season, and nearly all the trees had apparently suffered more or less

from browsing. The young almond trees, especially those which it was hoped would shortly bear crops to reduce the cost of maintenance, had a stunted appearance that gave little prospect of any kind. Only one almond tree had made anything like the growth expected, and that was flowering during my last visit to the garden. This browsing is not entirely due to encroaching cattle and wild animals, but I suspect a good deal of the damage might have been done by the donkeys when carrying water to the trees. It is now proposed to substitute bullocks for donkeys. About the middle of March the Conservator sent a capable young forester to take charge of this garden, and, though he was at first handicapped by very dry weather, I hope this work may show better results when I next visit the garden."

"Khairimurat in the Jullundur district under Fazal Dad has progressed quite satisfactorily. The trees have grown well and show the care that has been expended on them. A little more yield of fruit was obtained, I understand, during my absence, but this might have been better otherwise. The advices that are received from Italy regarding pruning are that the shaping of the trees at their present, or even earlier stage, is the most important thing, and the knife should be used freely to obtain this end, regardless of the fact that it practically stops present production. Fazal Dad loves his trees, and it is a little difficult to get him to be sufficiently drastic in his treatment of them. This however I have no doubt, can be overcome and better results attained before long.

"The total expenditure incurred during the year was Rs. 2,093 and income Rs. 41-13-0."

17. This quite unimportant branch of work continues on the lines mentioned in last year's report. The leghorns kept at Gurdaspur are in much demand in the neighbourhood. The cocks sent to Gujar Khan last year are said to be doing good there.

The central poultry farm attached to the Lahore Zoo has not had a good year, as it was impossible on account of the war to import new stock, which was absolutely necessary.

18. Before I mention the progress the use of improved implements is making in districts I wish to reproduce the following remarks by the Professor of Agriculture:—

"In addition to the advocacy of iron implements and ploughs, as the rajah, to the expense of which the zamindar often objects, efforts are being made at Lyallpur to produce and introduce a number of simple implements such as drills, harrows and hoes, which, though not so elaborate, efficient, or expensive as the foreign made articles, will, it is hoped, be a distinct improvement on any *desi* implements. The zamindar's implements are notoriously few and limited in application; little use is made of iron even in the simplest forms. It appears therefore that there is distinct room for the introduction of implements which, though cheap and simple, will serve the purposes for which the zamindar has no suitable tool. In the preparation of these implements wood is used whenever the course is not inconsistent with efficiency: they are so simple that they can be made by village carpenters and blacksmiths, and will cost but a few rupees. The work is not at present out of the experimental stage, but enough has been achieved to show that it should be possible by this means to eventually considerably improve the agriculture of the Punjab."

The attempt to make implements marking, as it were an intermediate stage in cultivation, which will be simple and can be repaired in villages (a most important point) is quite on the right lines. Mr. Faulkner recently noted:—

"The lack of a harrow of some sort for use in preparation of land and in young wheat is a most important cause of failure in ordinary barani cultivation. And though this Lyallpur-made harrow may not be so efficient as the spring-tined harrow for the first operation or the pegtooth (lever) harrow for the second, it will probably be much easier to introduce them on account of its lower cost."

For reapers, the year was a bad one, as labour was very much cheaper than usual at harvest time in the colonies, costing only about three-four of the 1915 rate. Still there was a distinct demand for new reapers, which the supplying firm was unable to meet, save to a very small extent, on account of the war. In the Chenab colony, of 131 reapers known to be in the hands of zamindars, 83 were used. Not infrequently they are owned jointly by groups of zamindars: and dissensions among the owners are, I regret to say, a not infrequent cause of the disuse of a reaper. Near Salarwala one is owned by a bank. The Lyallpur threshing machine was in considerable demand; the Gurdaspur machine is now at Sargodha, but it is too old really to be of much use.

As to ordinary implements, as meston and rajah ploughs, various harrows, drills, chaff cutters, etc., made in Europe or America, all have gone

up greatly in price owing to the war, and in very many cases indents for them could not be met at all by the supplying firms. The demand for hand-driven chaff cutters, particularly in Jullundur, is very keen, but supplies of these machines are at present unprocurable. Some banks, as last year, in Jullundur Hoshiarpur and Gurdaspur districts, stock meston ploughs for sale. The Registrar, Co-operative Credit Societies and I have recently agreed with the supplying firm that these banks should act as sub-agents for the firm, getting a small commission on sales and furnishing accounts of their sales every three months. This system works very well in the Central Provinces.

Considering the difficulties of the year, it is satisfactory, as shown in the following statement, to find that the numbers of improved implements sold in the year in the province was 348 more than last year. Details are as below :—

			<i>Sales in 1914-15.</i>	<i>Sales in 1915-16.</i>
Rajah ploughs	...	...	188	202
Meston	...	...	664	906
Other	...	...	16	79
Hoes	...	...	12	13
Harrows	...	...	35	55
Fodder cutters	...	...	60	58
Miscellaneous (grain kibblers, reapers, and mowers)	...	...	<i>Nil</i>	10
Total			975	1,323

In view of the great rise in price of the popular meston plough—from less than Rs. 6 to Rs. 9—I am having a comparative test made at Gurdaspur between the English and the Calcutta-made article. The latter's finish is very inferior, and general make-up poor: but it may be that we shall have to fall back on it. It is much cheaper than the English-made article.

As said last year many village blacksmiths in the Central Punjab districts now turn out quite passable imitations of the meston plough. Many hundreds of these must be in use.

19. I now pass on to district work which is, as I said last year, our most important work. The Deputy Director of Agriculture, Hansi, has charge of the south-east of the province, but has at present to confine his operations, owing to paucity of staff, to the Hissar, Ferozepore and Rohtak districts: the last he is only just able to touch. The Professor of Agriculture has charge of the Chenab and Lower Bari Doab colonies, and, in view of his duties at the college, is assisted by two Assistant Directors, one of whom is stationed at Lyallpur and one at Montgomery. The Deputy Director of Agriculture, Gurdaspur, has charge of the central districts of the province, and the Jhelum colony: his activities are at present confined to Gurdaspur, Jullundur, Hoshiarpur and Shahpur. Sialkot, Gujrat and Amritsar have also some work going on. We could take up much more work, had we a larger staff: experience has shown that it is most unwise to start work in any district unless an Agricultural Assistant can be posted there to attend to it. But we must go quietly in this matter; and, even was a large additional staff sanctioned, I would find it not easy at present to fill the posts, in view of the paucity of students who entered the Agricultural College two or three years ago.

Since last year Rohtak and Amritsar have come within our sphere of operations, and work in Sialkot is now on a much better footing than before. The agricultural associations mentioned in paragraph 17 of last year's report all are working: those at Shahpur and Hissar have now been formed. Of these some are naturally better than others: that at Lyallpur is far the best. On the whole, they do useful work. For the rest our propaganda in districts is carried on generally by the methods indicated in last year's report: demonstrations at fairs, if properly done, and touring demonstrations by a beldar, pair of bullocks,

and a few selected implements, are perhaps the most efficient means we have of making our methods widely known. The largest and most successful demonstration held was that at Tarn Taran (Amritsar district) during the Sikh Educational Conference last April: at it no fewer than 25,000 leaflets in Punjabi, issued by us on various agricultural improvements, were distributed but, only to men who asked for them. The demand was great. In addition to many men, some hundreds of Sikh ladies attended the demonstration.

The well-known Indian gentleman of Jullundur, whose land adjoins our Sargodha farm, whom I mentioned in paragraph 14 of last year's report, continues the process of conversion to our methods that I mentioned then. His munshi there asked permission this year to buy some more of our implements in addition to the ten rajah ploughs purchased last year. Asked by the owner how he proposed to meet the interest on the capital spent on these, the murshi sent to his master the results obtained from the use of our seeds and rajah ploughs, and compared them with the results obtained in former years: the outturn of wheat had increased from 1,200 to 1,900 maunds. As a result his master sanctioned an expenditure of Rs. 1,000 on the implements we recommend.

20. To cotton and wheat, in district work, I give separate paragraphs, as being our most important crops.

District work: cotton.

And of these two, cotton takes first place: an improvement in its quality gives an immediate return of perhaps Rs. 3 a maund, as we have found with our American cotton. In wheat, on the other hand, an increase in price to this extent, for an improvement in quality alone, would be out of the question: so in it an increase in outturn is the primary aim, with quality as a secondary consideration. In cotton an increase in both quality and quantity are equally important.

The 4-F American cotton of last kharif (see paragraph 21 of last year's report)—the principal advantage of which over country cotton is its greater yield and longer staple—all matured well, and much of it was sold by auctions held by the department at various centres in the Chenab and Jhelum colonies: in the former colony over 5,100 maunds were sold this way: in the Jhelum colony some 2,000 maunds. These auctions, in which the department only acts as organizer and arbitrator, and which may in some manner be regarded as co-operative sales, were generally very successful in securing for the growers a larger price than they would have got otherwise: they enable the buyers to obtain large quantities of cotton of great, and more or less guaranteed, uniformity: all cotton coming to the auctions is graded by us in accordance with its general condition but principally according to the proportion of country cotton mixed with it. Much work is involved by these auctions, as workable conditions for the sales to suit both buyer and seller have to be evolved. The local buyers, especially at Lyallpur, indeed objected to our conditions, and sometimes boycotted us. But we got Tata & Sons of Nagpur, an enterprising Japanese firm, and the local European firms to attend our auctions, with the result that we got excellent prices, and the local opposition proved quite fruitless. Very large amounts were also sold privately. The premium over the price of country cotton per maund was generally between Rs. 2-8-0 and Rs. 4 varying according to the class in which the cotton had been placed. It can be understood that, with this large premium, the areas under this cotton have increased very considerably this year, and have indeed only been limited by the amount of seed available, which fetched twelve annas a maund more than the ordinary seed. It is estimated that the acreage under this cotton now is as follows. I give also last year's figures for comparison:—

	1915.	1916.
Chenab colony	6,000	30,000
Jhelum colony	1,200	7,000
Lower Bari Doab Colony	500	13,000
Total	7,700	50,000

The figures for the Lower Bari Doab colony are remarkable: it is said that the colony is better suited to American than to country cotton.

Much work is, it will be understood, involved in supervising this large area of good cotton. American cotton calls for better cultivation than country cotton, and the price drops with great rapidity if country cotton is mixed with it. Sirdar Jogendra Singh's store-keeper at his farm in the Lower Bari Doab colony last year mixed his country and American cotton—he had only a small area of both combined—but he thereby involved his master in a loss of at least Rs. 350. All the time of the touring staff is therefore occupied during the summer in getting the cotton fields properly hoed and rogued. We always keep under our immediate control as large an area as possible of absolutely pure 4-F American cotton to form a reserve of seed: and at the auctions we reserve (and always exercise) the right to buy back the seed of the purest cotton sold, which we then have specially carefully ginned, the gin-owners being compensated for the extra trouble involved. In this connection one mill-owner last December at Sargodha said he would pay Rs. 11 per maund for the best cotton, if we would forego our claim to buy back its seed. Asked why, he said he would mix the American with country cotton, and sell the seed also mixed. Needless to say his offer was not accepted, and the cotton eventually fetched Rs. 10-11.3 per maund (country cotton was selling at Rs. 7-8-0) the department having the right to repurchase the seed.

One small village, chak No. 94-S. B. in the Jhelum colony, has—thanks to Mr. Strickland, Assistant Registrar, Co-operative Credit Societies—agreed to grow in its entire area only 4-F American cotton and Punjab 11 wheat. If this example is followed, it would considerably facilitate the marketing of the cotton, large amounts being available within a small radius. It will also render less probable the crossing of this 4-F cotton with other American cottons, of which a certain number exist here and there in the colonies, and which is one of the dangers we have to guard against.

Much credit is due to the officers of the department, particularly to Mr. Milne, Economic Botanist—4-F was one of his selections—and most of all to Mr. Roberts, Professor of Agriculture, for the success which has attended the operations with American cotton. In this connection I should make special mention of Mr. Kitchen, Deputy Commissioner of Lyallpur, whose assistance in smoothing away the difficulties that appeared in the cotton auctions was invaluable.

No country cotton has yet been put out with zamindars, save a small amount of *Gossypium sanguineum*, which did not do much good. Probably the south-east of the province (in which the Hansi farm is situated) will provide a more favourable field for country cottons than do the colonies. Whether indeed there will remain any country cotton at all in the colonies after a few years, should 4-F continue to be as successful as at present, is a disputed point. Many experienced zamindars say no. But Mr. Roberts thinks there will always be an opening for country cotton in parts of the colonies where owing to poor soil, bad cultivation, or defective water-supply, American cotton cannot thrive.

21. The following acreage last rabi was under wheat we had distributed to zamindars.

District work: wheat.

The figures may be compared with those given in paragraph 20 of last year's report:—

			Punjab 11.	Pusa 12.
Chenab colony	...	...	17,000	300
Jullundur	...	...	...	750
Hoshiarpur	...	...	...	820
Gurdaspur	...	...	...	800
Jhelum colony	...	...	7,500	...
Lower Bari Doab colony	...	...	3,000	...
Total	...	...	27,500	2,670

In addition small areas were under Pusa 12 and Punjab 11 and 14 in the Ferozepore, Hissar and Rohtak Districts. To the colonies, Punjab 11, a bearded wheat with amber grain, is, as already said, the wheat best suited that we have so far discovered. The comparative merits of it and Pusa 12 were well summed up by the Professor of Agriculture in his report on the Lyallpur farm, which formed Appendix VI to last year's report. With us this wheat nearly always yields more than Pusa 12 on canal irrigated land, and this is the all important matter. It appears well suited to the Lower Bari Doab colony. Last May Captain Vanrenen of the Renala Estate in that colony wrote to me as follows: "Punjab 11 saved the situation for us this year. The tenants of our best irrigated village, where there is also the best land, refused the seed and sowed their own. The consequence is that the wheat crop in that village is a failure, because I think they used rust infected seed. All our other tenants used the No. 11 you sent us, and they have excellent crops."

Arrangements were under consideration to send an entire shipment of Punjab 11 wheat to England, but the matter had to be dropped for the present on account of the war. It will be taken up again as soon as circumstances permit. This is a most important matter if we want to get our wheats known on the home market, and thus get a higher price for them. Pusa 12, a beardless white wheat, is becoming popular on well irrigated land in the Central Punjab. It is possible also that a limited opening may be found for it in the colonies on account of its earliness compared with Punjab 11. It did well on the few wells on which it was grown near Ferozepore. Both Punjab 11 and Pusa 12, where they were grown, yielded about a maund an acre more than the country wheats they replaced. As to barani lands, no wheat did really well on them last winter owing to the absence of rain.

For the next crop over 9,000 maunds of Punjab 11 are being stored in the Lower Bari Doab, 20,000 maunds (at 72 centres) in the Chenab, and about 10,000 maunds in the Jhelum colonies. Of Pusa 12 seed about 8,000 maunds are being stored in the Central Punjab districts. These amounts, which are in addition to an indefinite amount stored over which the department exercises no control, are all under careful supervision by the agricultural department. Wherever possible arrangements are made by which the grower remains in possession of the wheat, but we assist in advertising and distributing it. In other cases, especially in the Central Punjab districts, banks are storing the wheat, to distribute it at sowing time to their members: and in some cases, where neither of these arrangements is possible, the department actually buys the wheat and sells it at sowing time. In this way some 5,000 maunds of Punjab 11 belongs to the department at the present moment in the Chenab colony, and will be sold at sowing time. The obstacles which prevent banks embarking on the work to a greater extent than at present are (a) the difficulty of arranging for the safe storage of a large quantity of grain for the monsoon months: and (b) the dislike to facing a possible financial loss should the price of grain drop between the harvest and sowing time. Both these important matters are receiving constant thought, and will doubtless be solved before very long. Each province must find its own salvation in these matters, though most useful hints can be gathered from other provinces, and no opportunity is missed of collecting these. Meanwhile the Agricultural Engineer is erecting a small model grain godown at Lyallpur, which will be most useful to us as a pattern when the time comes for the erection of such buildings in the wheat tracts as it must sometime. The district board of Hoshiarpur has indeed nibbled at a proposition to put up seed godowns of its own, but so far nothing has come of it.

22. I here summarize the most important of the other lines of work we are encouraging in districts. The sowing of maize and cotton in lines, and subsequent inter-culture: generally the use of furrow turning ploughs (for breaking up over grown lands, sugarcane cultivation, etc.): the use of spring-tined harrows for breaking crusts and conserving moisture: the use of hoes for interculture: the harrowing of young crops: green manuring with sunn hemp (this is only recommended for poor or kallarish land): the destruction of moth borers in canes

Other activities.

By cutting out dead hearts : ensilage, and the conservation of farm yard manure in covered pits : the growth of Japan sarson for fodder (this is very popular in Jullundur) : the growth of Scotch potatoes in the Simla hills (these are very successful, and a much higher price is paid for them, especially for seed purposes, than for ordinary potatoes) : the growth of the long eared Australian bajra in barani tracts (most popular) : and the extirpation of the pohli weed by cutting it in May. This weed was altogether destroyed in this way in nearly all Jat zails of Nawashahr Tahsil (Jullundur) this year, as Mr. Wilson, Assistant Settlement Officer, assured me. The Rajputs, as was to be expected, made considerably more difficulty about doing this.

Progress in all these lines of work is taking place : but, as we have the conservatism of ages to overcome, it is naturally slow. And we have not only conservatism to overcome, but prejudice and superstition. In parts of the Lyallpur Tahsil green manuring is objected to on the ground that a man who grubs under a standing crop in flower will certainly be visited by some calamity by the goddess of crops : and in Montgomery I was assured that the best remedy for the aphid which affects cotton is the smoke of the singed hair of the wife of an oilman.

I should make a brief mention of jute and indigo crops which have gone up greatly in price owing to the war. Both have received considerable attention from the agricultural department. Jute can be grown quite satisfactorily in the Punjab, but cannot be retted, owing to the very large amount of water required. We are waiting the results of some experiments the Fibre Expert to the Government of Bengal is making in a retting machine that will obviate the use of water. As to indigo, we decided it would be unwise to take any steps to push the crop, till we have some certainty that the rise in its price will be fairly permanent. But if we are asked for seed we do all we can to provide it : and I find that in parts of the east of the province the people are themselves putting an increased area under indigo and repairing the old indigo vats that formerly existed.

23. Our farms yearly receive a larger number of visitors who generally take a keen and intelligent interest in all they see. I quote the following as merely one instance of what often follows visits to these farms. A party of zemindars from the Chunian colony (which we have not touched) visited the Lyallpur farm last spring and immediately on their return home bought 7 meston and 1 rajah plough, and 30 maunds of Punjab 11 wheat to sow this autumn. The department is certainly getting better known and more appreciated every day. Much of the criticism that is passed on it is due to want of information. This must be my excuse for the length of this report. It should also be remembered that, with our operations increasing every day, it is impossible to keep the report of one year to the length that was sufficed for its predecessor.

The staff have all worked well during the year : and I must mention also my office which bears bravely an ever-increasing load of work.

C. A. H. TOWNSEND,

Director of Agriculture and Industries, Punjab.

Dated 15th September 1916.

APPENDICES.

APPENDIX I.

Report of the Principal, Punjab Agricultural College.

I HAVE pleasure in reporting a satisfactory year's working for the session 1915-16. A keener interest has been shown by the public in the college, and there has been an increasing demand for admission by students. The class of applicants this year is superior to that of former years which in itself is a good augury for the future. The college income has increased, and its expenditure diminished during the past year.

The seventh session of the college opened on the 20th July 1915 with a second year class of 19, and a first year class of 40 students, thus making in all 59 students on the rolls of the college: of them 16 subsequently resigned and two were dismissed on account of misdemeanour; so the number on the rolls at the end of the session was 41. The class for revenue officers in Indian Rural Economy was held from 20th February to 24th March. It was attended by 20 students, 3 Assistant Commissioners, 3 Extra Assistant Commissioners, 2 Assistant Engineers and 12 Zilladars.

Vernacular class.—Out of 54 applicants for admission to this class, 31 were admitted, and 24 completed the course. With the exception of 7 students all were sons of agriculturists. Three students belonged to the Jind state and two came from the Kot Fateh Khan estate in the Attock district. This class has proved a success and is becoming popular.

Caste of students.—The following table gives the classified list of students who attended the college in the year under report:—

Europeans	...	...	...	...	4
Indian Christian	...	...	...	...	1
Muhammadans	...	...	...	...	19
Hindus	...	...	...	...	33
Sikhs	...	...	...	...	29
Total					86

Examinations.—The first Leaving Certificate Examination was held from the 5th to 15th May 1916. Nineteen students appeared and all passed.

Mr. G. Evans, Deputy Director of Agriculture, Central Provinces, Jubbulpore, officiated as External Examiner in Agriculture: the examiners reported favourably on the students.

The examination of the first year class was also held simultaneously. Of the 22 candidates who presented themselves for examination, 20 passed and 2 failed.

Scholarships.—Of the 10 candidates who were awarded Government scholarships last year, 6 joined the college, but one left subsequently, so we had 5 scholarships vacant at the end of the session. These have been awarded on the result of the Sessional Examination held in May 1916. The Entrance Scholarship Examination for the year 1916-17 was held on May 8th, 1916; 35 candidates presented themselves for examination of whom 10 have been awarded Government scholarships.

The candidates were of a satisfactory type and I selected a number from among them as fee-paying students.

Scholarships awarded by District Boards and private donors.—Following is the list of donors of scholarships:—

ENGLISH COURSE.

District.	Name of donor.	Value of scholarship per month.
		Rs.
Jullundur	District Board	15
Ferozepore	" "	10
Jhang	" "	6

VERNACULAR CLASS.

District.	Name of donor.	Number of scholarships.	Value of scholarship.
			Rs.
Rohtak	District Board	4	7 per mensem each.
Karnal	" "	3	7 " " "
Ludhiana	" "	3	5 " " "
Ferozepore	" "	1	10 " " "

VERNACULAR CLASS—concluded.

District.	Name of donor.	Number of scholarships.	Value of scholarship.
			Rs.
Hoshiarpur ...	District Board	1	5 per mensem.
Sialkot ...	" "	2	5 " " each
Gurdaspur ...	" "	4	5 " " "
Gujranwala ...	" "	10	5 " " "
Multan ...	" "	4	5 " " "
" ...	Khan Bahadur Sheikh Riaz Hussain.	2	5 " " "

I wish to express my thanks to all these donors for their generous support of the cause of agricultural education. It has been suggested to all district boards that in awarding a scholarship to this class the amount of the grant should be Rs. 50, and also, to avoid delay in the payment of fees, that the amount of the scholarship should be paid in advance.

Government research scholarship.—The holder of this scholarship, Kartar Singh, has completed his course of study in dairying and is now engaged in writing up the results of his enquiry.

No suitable holder of a scholarship was forthcoming this year.

Special lectures.—At my request, Professor Todd, Punjab University lecturer in Economics, delivered three lectures on the "World's Cotton crop." The lectures were well attended.

Hostel, clubs, etc.—The general health of the students has been satisfactory. Social-intercourse between staff and students has been good, and the athletic club records above the average.

Library.—The library is in the process of being reorganised according to the system introduced in the Punjab University Library by the Librarian Expert, Mr. A. D. Dickinson. The services of a man trained by Mr. Dickinson have been secured for this purpose.

Staff.—Mr. Roberts proceeded on seven months' leave on 28th April and Mr. O. T. Faulkner is officiating for him.

Lala Ramji Narain, M.Sc., was appointed demonstrator from 1st January. The post, however, again fell vacant in consequence of Lala Ramji Narain's appointment as research assistant in the chemical section from 1st August, 1916. Mr. T. M. Nair has been appointed demonstrator; he reported himself on the 1st August.

Expenditure.—The expenditure on the college during the past year has been :—

	Rs.
Pay of officers and establishment ...	63,838
Travelling allowance ...	13,360
Contingencies ...	30,459
Total ...	1,07,657

The income and expenditure of the past five years has been as follows :—

<i>Expenditure.</i>					Rs.
1911-12 ...	...	...	...	...	92,517
1912-13 ...	...	...	...	...	98,277
1913-14 ...	...	...	...	...	1,10,593
1914-15 ...	...	...	...	...	1,55,955
1915-16 ...	...	...	...	...	1,07,657
<i>Income.</i>					Rs.
1911-12 ...	...	...	...	...	8,290
1912-13 ...	...	...	...	...	11,739
1913-14 ...	...	...	...	...	7,553
1914-15 ...	...	...	...	...	9,088
1915-16 ...	...	...	...	...	16,691

J. H. BARNES,

Principal, Punjab Agricultural College, Lyallpur.

APPENDIX II.

Report of the Agricultural Chemist.

Staff.—Lala Ramji Narain, Punjab University Research scholar, who has been studying in this laboratory for the past 3½ years, has been appointed senior research assistant in chemistry. The post of demonstrator in chemistry has been filled by T. M. Nair, L. T. C., of Bombay.

Provincial work in Agricultural Chemistry.—This work has shown a slight decrease during the year; 176 samples being analysed as against 200 last year.

Research.—During the year under report the research work in agricultural chemistry already in progress has been carried on and extended, and several results of importance have been obtained. The following are the main lines of work which have been pursued :—

A.—Narwala experiment in the reclamation of alkali soils.—In the first year of the experiment the land was deep cultivated and mole-drained with Fowler's steam plant and afterwards washed with irrigation water. At the end of the season the test crop of wheat sown showed that on part of the farm the washing had been insufficient. This land was consequently re-drained and again washed in August and September 1915 and wheat sown there in the following autumn. The results were satisfactory, this portion of the land being cleaned and rendered suitable for the growth of wheat. At the same time the whole farm was again deep cultivated and the land tested with maize, toria and rice. The following crop results were obtained :—

Wheat.—The area under wheat was about 43 acres. Since the washing of the land was continued until late in the year, the soil was not in a uniformly good condition for wheat sowing. In spite of this, the crop was an excellent one; the highest outturn obtained being 37·8 maunds (nearly 52 bushels) per acre. The results obtained compared with those of last year are as follows :—

			1915.	1916.
			<i>Yield per acre</i>	<i>Yield per acre</i>
			<i>in maunds</i>	<i>in maunds</i>
			<i>(wheat).</i>	<i>(wheat).</i>
Highest	...	...	26·5	37·8
Lowest	...	...	13·4	15·4
Average	...	...	18·6	22·3

The land on which the greater part of this wheat was grown was the worst on the farm, some of it being entirely barren to start with, and even at the end of the first treatment it was very uneven and contained isolated patches of "Kallar" rendering the ground there sterile.

Rice (about 9 acres).—Considerable difficulty was experienced in puddling the fields for rice owing to the previous deep cultivation having rendered the sub-soil porous to water. Consequently large quantities of water had to be used for the growth of the crop, and this resulted in the removal of manurial constituents of the soil and reduced its fertility. This same land was afterwards sown with mixed gram and barley, and was still in a very impoverished condition in the spring of 1916. Both these crops were very uniform in growth, and the fields in which these were grown will now rapidly regain their full productive power. The dry season of 1915 was very detrimental to the rice crop.

Maize (about 10 acres).—This crop was good on the soils which had been thoroughly washed. Where traces of alkali still existed the germination of the maize crop was patchy. This crop is very delicate towards alkali salts, and its proper germination and growth may be taken as a sure indication of the thorough cleaning of the land.

Toria (34 acres).—This crop does well on newly reclaimed land; the presence of traces of salts, particularly sulphates, being beneficial rather than otherwise. The whole crop gave promise of being a bumper one—the land, however, proved too strong for it and the crop became too heavy for the straw, and a large portion of it fell and consequently never ripened. The outturn, however, was good.

Barley and gram mixed.—This was sown after rice, and the results obtained have been referred to above.

This year's work justifies the views expressed in last year's report that this method of reclaiming alkali land within the canal colonies is likely to prove a commercial success. The cost works out to a varying figure according to the amount of salt present and the density of the soil, thus necessitating more or less washing with water. The principal items of expenditure appear to be the preparation of level fields and the cost of water. This first is an essential feature of the treatment, for otherwise even washing cannot be secured. The cost of levelling will, of course, vary enormously, and I think it should be done by machinery as part of the reclamation work when working on a large scale. I append a series of tables showing the outturn per acre of the various crops grown at Narwala during the past year.

B.—Sugarcane in the Gurdaspur District.—The examination of district canes has been completed, and the work now in progress at Gurdaspur Experimental Station has been chiefly confined to manurial experiments on cane, the testing of cane varieties and an investigation into the effect of cold on the sugar contents of the juice of different varieties. The report of the district cane is in course of preparation, and will be shortly offered for publication as a bulletin of the Department of Agriculture in India. As a result of this work, I have narrowed down the lines of investigation and shown in what direction we can hope to achieve improvement of this industry in the Punjab. One of the most important deductions arrived at is that the Punjab is outside the proper cane zone, and that as economic conditions adjust themselves and more sugar is produced elsewhere in India, the Punjab industry must of necessity decay and can be replaced by the more remunerative crops of wheat, cotton and oilseeds, which find a natural home in the more rigorous climate of Northern India.

C.—Sugarcane in the Southern Punjab.—The district canes in the Southern Punjab have been under study in the Karnal District during the past year. As a result of two years' work there, I consider that better canes are to be found in this district than in Gurdaspur, and I am of the opinion that our sugar investigation should, for the future, be confined to one of the southern districts. There seems to be a chance of effecting improvement in manufacturing methods, and in this connection a visit was paid to the experimental small factory at Nawabganj erected by the sugar engineer, Mr. Hulme. The losses in gur manufacture as judged by my Gurdaspur results appear to be very high. They amount to a loss of about half the sugar present in the cane. About 20 per cent. is lost in milling, 10 per cent. in boiling and the remainder in a manner so far unexplained. These results will be found in full in the report referred to. A separate report on the Karnal results is in course of preparation.

Besides district work a number of special problems relating to the ripening of cane and the formation and storing of sucrose have been under study in the chemical laboratory. The results will be shortly offered for publication. At this stage they are for the most part of scientific interest only.

The mineral constituents of cotton lint.—This investigation was undertaken at the request of a firm interested in exporting cotton from India who received complaints from spinners in England that Indian cotton showed abnormality towards dye-stuffs, and attributed this to the artificial addition of hygroscopic salts to the cotton—added, it was supposed, to increase the weight of the bales. The first part of the investigation has already been published, and shows that these salts are a normal constituents of pure cotton lint. Further investigations are being made on different types of cotton grown at Lyallpur.

Bacteriology of alkali soils.—Excessive washing of alkali soils was found to result in the soil losing its nitrifying power; the nitrifying organism being still present, but in an inactive condition. Further study indicates that the nitrifying organisms require both potash salts and phosphates, and these had been almost entirely removed by washing. The low fertility of the rice fields at Narwala was thus accounted for.

A study of these soils shows that nitrogen fixing bacteria were not normally found at a lower depth than 6 inches, while both ammonifying and nitrifying organisms were present at a depth of 9 feet from the surface,—this being the lowest depth to which the investigation was carried.

Lyallpur municipal water-supply.—A thorough study, both chemical and bacteriological, of this water-supply, which is canal water purified by sedimentation and sand filtration, has been made during the past year. The result of this enquiry is that sand filtration of water by percolation appears to be highly unsatisfactory. The results will shortly be published.

Problems connected with the rise of spring level in the Lower Chenab Canal Colony (seepage experiments).—The line of study followed last year has been continued, namely, the measurement of the amount of water lost by evaporation from the sub-soil water-table. This includes the collection of fuller information on the movements of the gases of the soil under temperature and pressure variations. In addition to this the Irrigation Department have joined me in this research, and have built two gauges for this investigation, one on the college farm and another under the Rakh Branch near Lyallpur.

With the first of these gauges, we expect to measure the losses which take place after the irrigation water has been applied to the field. There is some evidence that these losses are upwards of 66 per cent. of the whole water applied. With the second gauge, we shall directly measure the absorption rate on the canal bed. It is too soon to give any results as these gauges have only just been constructed, but the measurements so far obtained show that Kennedys' absorption value is too low, and also that his assumption that absorption is independent of the depth of the water above absorbing surface is unwarranted.

I wish to acknowledge with thanks the interest and help, both professional and financial, accorded by Mr. Ward, Chief Engineer in the Irrigation Department, in this investigation. We have so far only made a start, and the staff and time at my disposal are both very limited. The results, however, are well up to my expectations, and give promise of valuable information being obtained on these important problems during the next few years.

Water from tube wells.—Water obtained from tube wells at Dera Ghazi Khan has been found to give a heavy yellow deposit, staining the vessels in which the water is stored. This defect was pointed out to me by the Sanitary Engineer to Government and the Deputy Commissioner of Dera Ghazi Khan. Investigation shows that the water tapped by these tube wells contains a considerable quantity of iron in a reduced condition, which on aeration of the water leads to the formation of a deposit of hydrated oxide of iron. This excess of iron in solution has resulted in the growth of *Crenothrix* on the water pipes at Dera Ghazi Khan. Further investigation shows that all the Punjab sub-soil waters tapped by tube wells contain iron in this reduced condition—the amount increasing as we get further away from the hills. The whole question is an important one; as it will mean that expensive aeration and subsequent filtration will have to be resorted to when these waters are used for municipal purposes, since the growth of *Crenothrix* is otherwise likely to give trouble by blocking the pipes.

Sugar beets.—In 1913 seed obtained from Germany was divided and tested at Lyallpur and in Kashmir. The crop gave no seed at Lyallpur, but the Kashmir crop gave seed, which seed was tested in Lyallpur and in Kashmir. The experiments were continued up to the present season. The results show that roots containing as high as 14½ per cent. of sucrose can be grown at Lyallpur from seed raised in Kashmir, and in Kashmir itself roots containing as much as 16½ per cent. sucrose have been grown.

This experiment is very satisfactory, as it shows that suitable beet seed can be raised in the colder climate of Kashmir for use in the Punjab or North-West Frontier Province. It also demonstrates the suitability of the Kashmir climate for beet cultivation, where the possibilities of a beet sugar industry are very promising.

A separate report will be issued later.

Publications issued from the Lyallpur laboratory during the year 1915-16.

The insect pests of stored wheat in the Punjab. Memoir of Indian Department of Agriculture.

In the press :—

A note on the mydriatic alkaloids in the Indian Hyoseyamus (H. Muticus)—“Agricultural Journal of India,” January 1916.

Poli oil.—A new adulterant of ghee.—“Analyst,” March 1916.

Mineral constituents of cotton lint.—“Journal of Society of Chemical Industry.”

J. H. BARNES,

Agricultural Chemist, Punjab.

Statement No. I.

STATEMENT SHOWING THE OUTTURN OF RICE GROWN AT THE REH FARM, NARWALA, DURING KHARIF 1915.

Number of field and square.	Treatment given.	AREA.			TOTAL OUTTURN.		OUTTURN PER ACRE.		REMARKS.
		Acre.	Kanal.	Marla.	Maunds.	Seers.	Maunds.	Seers.	
16 1	Ordinary cultivation	1	1	17	8	10	6	28	
16 2	Ditto	1	2	12	9	10	6	39	
16 3	Deep cultivation	1	3	1	10	18	7	23	
16 4	Ditto	1	2	17	17	1	12	22	
16 5	Ditto	1	...	18	18	...	11	31	
16 8	Ditto	...	3	10	3	10	7	17	
16 9	Ordinary cultivation	1	3	...	8	20	6	7	
16 10	Ditto	...	4	...	10	20	21	...	
	Total	8	5	13	80	9	...	...	
	Average outturn per acre	...	...	...	...	...	9	8	

Statement No. II.

STATEMENT SHOWING THE OUTTURN OF MAIZE GROWN AT THE REH FARM, NARWALA, DURING KHARIF 1915.

Number of field and square.	Treatment.	AREA.			TOTAL OUTTURN.		OUTTURN PER ACRE.		REMARKS.
		Acre.	Kanal.	Marla.	Maunds.	Seers.	Maunds.	Seers.	
16 6	Deep cultivation	1	...	15	18	37	17	12	
16 7	Ditto	1	3	...	26	10	19	4	
3 9	Ditto	1	7	2	40	...	21	7	
3 8	Ditto	2	...	9	28	23	13	36	
3 7	Ditto	1	7	12	28	19	14	24	
3 6	Ditto	1	3	2	20	30	14	33	
<	Total	9	6	...	162	39	...	...	
	Average outturn per acre	...	...	...	...	...	16	25	

[illegible]

Statement No. IV.

STATEMENT SHOWING THE OUTTURN OF WHEAT GROWN AT THE REH FARM, NARWALA, IN RABI 1916.

Number of fields and square.	Treatment.	Area in acres.	ACTUAL OUTTURN.		OUTTURN PER ACRE.		REMARKS.
			Mands.	Secs.	Mands.	Secs.	
1	Ordinary cultivation	1.58	51	15	32	21	
2							
1	Ditto	1.33	48	25	36	22	
2							
1	Ditto	1.46	43	5	29	21	
4							
1	Ditto	1.67	47	20	28	18	
5							
1	Ditto	6.25	22	20	36	...	
6							
1	Ditto	1.72	65	...	37	32	
7							
2	Deep cultivated and redrained	2.35	45	...	19	6	
1							
2	Ditto	2.36	42	20	18	...	
2							
2	Ditto	2.40	45	10	18	34	
3							
2	Ditto	2.30	49	10	21	16	
4							
2	Ditto	2.62	64	10	24	21	
5							
2	Ditto	1.62	39	33	24	23	
6							
2	Ditto	2.31	45	...	19	19	
7							
2	Ditto	2.41	36	22	15	16	
6							
2	Ditto	2.10	42	20	20	5	
9							
2	Ditto	2.39	39	15	16	20	
10							
2	3 drains made	1.93	45	...	32	14	
1							
3	Cultivated and drains made	2.39	42	20	17	31	
1							
3	Ditto	2.42	47	20	19	25	
3							
3	Ditto	2.62	52	20	20	1	
4							
8	Ditto	2.0	44	37	22	18	
1							
3	Ditto	0.16	3	10	20	22	
3							
Kuttar Road.	Total	42.765	963	25	...	...	
	Average outturn per acre	...	...	...	22	21	

APPENDIX III.

Report of the Economic Botanist, Punjab.

Cottons.—General.—Cottons were again grown on the 10 acre block of land, which on the whole is a light loam and through which several streaks of very sandy soil pass. Blowing sand did a lot of damage to the young plants just after they came above ground.

The summer season was excessively dry and hot and caused a very large number of early formed cotton flowers and bolls to fall throughout the Punjab plains. The crop was, therefore, generally a miserable one, especially the desi cottons, which, owing to their comparatively short flowering season, lost a large proportion of their crop in this way. American cotton having a much longer flowering period formed new bolls later and produced a crop comparatively much better than the desi. Bollworm also appeared to some extent in some districts. Our experimental cottons at Lyallpur suffered to a considerable extent from the drought and heat, and a flight of locusts on 30th August did further heavy damage.

Acclimatised American Dharwar cottons.—The American cottons grew on the same block of land in the season 1912-13, and it was noticed by ourselves and Tata and Sons (who kindly examined the fibres) that the samples contained extraordinary amounts of long and short, weak and strong fibres that year. We noticed that where the land was most sandy this was most pronounced, and that where one variety was growing on such land and also on land of ordinary quality, the irregularities referred to were not found in the latter. In the past two years, i.e., 1913-14, 1914-15, when cottons were grown on medium lands these irregularities disappeared. This year 1915-16 we again noticed the irregularities noted in 1912-13 and Messrs. Tata and Sons in their report on the fibres also notice the same. These irregularities seem to be due to deficient water holding power in the sandy soils, and attempts are being made to arrange experiments to give further data on the point. Meantime it is very important to note that American cottons should not be grown on very sandy land, not only because of the much poorer crop which they will produce there, but because if their lint is mixed with that grown on medium loam the regularity of length and strength of the fibres of the whole consignment will be much impaired.

The fibre of desi cottons being comparatively short and rough is not so much affected when these cottons are grown on sandy soils.

In the past year we have had reports from several places that both American and *desi* cottons have had a lower kan (proportion by weight of lint in the unginned cotton) than usual by 1—5 per cent. This is also apparently connected with the excessive drought and heat.

In spite of the very bad season, poor soil, etc., a number of the American selected cottons in the experimental area yielded 10 maunds or over of *kapas* (unginned cotton) per acre on areas ranging from $\frac{1}{11}$ to $\frac{1}{4}$ acre each, and selections 280 F. and 275 F. gave 14 maunds approximately on $\frac{1}{8}$ and $\frac{1}{4}$ acre plots, respectively. Owing to the unequal quality of the land comparisons of outturns are of little value however.

On very rich lands a number of selections gave 13 to 16 maunds approximately of *kapas* on $\frac{1}{11}$ acre areas. Experiments conducted with selected American cottons grown on both trenched and untrenched highly manured lands and on ordinary lands gave us the following general data :—

- (a) The outturn of *kapas* was much greater on trenched than on ordinary land.
- (b) There was little difference in the kan.
- (c) The lint tended to be rather longer and finer on the ordinary land and generally spun rather higher counts.

These experiments are being repeated.

Messrs. Tata and Sons valued about 60 samples of American cotton for us. Their basis of valuation was the price of well-known cottons on the same date, viz.—

Tinnevely, Rs. 345, Hinganghât, Rs. 275, Surat, Rs. 350, Navsari, Rs. 365, Broach, Rs. 290, Fine Bengal, Rs. 230, American Middling spot Liverpool, 8.56 per lb.

Briefly the report on our cottons is as follows :—

				Spinning counts.	Price per candy of 784 lbs. Rs.
168 F., plant I	...	...	...	50 S.	500
72 F.	...	...	...	50 S.	450
Cross No. 12, plant II	...	...	...	50 S.	425
101 A. F.	...	...	...	44 S.	400
274	...	...	...	44 S.	400
280 F., plant I	...	...	...	50 S.	400
282 F.	...	...	...	50 S.	400

And very many samples valued between Rs. 350 and Rs. 400.

Some interesting results have been got from environment experiments this year. These will be continued.

Desi cottons.—The main types of *desi* cottons have now been separated some years and are being tested from the economic point of view.

At present No. 135 A. G. Indicum

- „ No. 24 A. G. Indicum, var. Mollesonea
- „ No. 109 A. G. Neglectum, var. Major
- „ No. 80 A. G. Neglectum, var. Rosea
- „ No. 20 A. A. G. Sanguineum, var. Major
- „ No. 28 D. A. G. Sanguineum

have been handed over to the Professor of Agriculture on the Lyallpur farm and are being tested on a field scale by him.

A duplicate lot except 28 D. G. Sanguineum is being tested at Hansi by the Deputy Director of Agriculture there. No. 40 G. Neglectum, var. Rosea, is now being tested on the Sargodha seed farm by the Deputy Director of Agriculture, Gurdaspur.

More will be tested as occasion offers.

Wheats—General.—Ten acres experimental and 1 acre non-experimental lands were occupied by wheats: 8½ acres were of medium loam and 2½ acres were rather sandy and poor. The season throughout was very favourable for the crop on our lands. Practically no rust appeared; the crop was well grown and the grains were very well developed.

Punjab natural types.—The 25 originally classified types of Punjab wheats were grown on small plots. The 36 new types found from surveys, etc., in the province were grown on areas ranging from $\frac{1}{8}$ to $\frac{1}{4}$ acre each. To compare their cropping and other powers they with all others on plots of these areas or over, were as usual grown alongside of each other in long narrow strips with type No. IX at intervals as a standard.

Types VIIIA, VIIIB, IXA and IXC gave the heaviest outturns among the bearded types. Excepting IXA, which is a red wheat, they are all hard amber grained. Among the beardless types XVIIIA, XVIIIB, XVIIIC, XVIIIIA and XXIIIA gave the heaviest outturns. They are all red grained, except XVIIIIA, which is light amber, hard grained.

For detailed results of the year's cropping tests of the 36 new types referred to see statement A.

Crosses.—Over 100 crosses were grown on $\frac{1}{32}$ acre area each with No. IX as a standard at intervals. Seventy-three of these have been selected for further tests. Some of them are very promising. A large number of crosses were also grown in single rows. Seeds of the best of these have been kept.

Canadian wheats.—Four types of suitable Canadian wheats were grown. The grains received from Canada did not compare favourably in appearance with the best Punjab types of wheats. The crop got from them matured so late that the hot winds shrivelled the grains badly, and the amount of grain got per acre was poor.

Ear-cockle on wheat.—It has now been definitely proved that the *Tylenchus*, which forms the ear-cockle in wheat, also causes the gummy disease on wheat heads, the cause of which has so long been a mystery.

Work is being continued on this and also on root rot in cotton.

Barley and grams.—From the collection of Punjab barleys over a dozen types have been isolated. Work in connection with their comparative agricultural, making and other economic properties is proceeding.

From the collection of Punjab grams, over 2 dozen types have been isolated. Their economic properties are also being compared.

Scotch potatoes.—Eleven varieties of Scotch potatoes grown in the Simla hills last year interstripped with the local *desi* potatoes and occupying altogether an area of 1½ acres, gave an average value of Rs. 374 gross income per acre, as compared with Rs. 197 per acre from the *desis* grown along with them. All available seeds have been eagerly bought up by zamindars in the neighbourhood of the experiment. The work is being continued.

Date-palms.—The fruits from the imported Arabian trees are of better quality than those from the best local trees, and these in turn are of far better quality than the average local fruits. We sold our Arabian fruits last year at annas 6 per lb. done up in card board boxes, and we could not supply the demand for these. The average price of country dates varies between Rs. 5 and Rs. 10 per maund. A publication on the subject in English is in the press and one in Urdu will follow soon.

Miscellaneous work.—Work has been done on fodder crops, such as oats, kara grass and Japan rapeseed; also on maize, fig and other crops, and district surveys of cottons and various investigations undertaken.

D. MILNE,

Economic Botanist, Punjab.

Statement A.
NEW TYPES OF PUNJAB WHEATS.

Type No.	DATE OF			OUTTURN PER ACRE.				REMARKS.
	Sowing.	Earing,	Ripening.	Grain.		Straw.		
				Mounds.	Seers.	Mounds.	Seers.	
VIIIA	4th November 1915	8th March 1916	14th April 1916	40	0	92	0	Tillers well; all crop slightly bent down; trace of rust; grains amber, hard and of medium size.
VIIIB	Ditto	26th February 1916	10th April 1916	36	0	71	8	Stands and tillers well; trace of rust; grains amber and hard.
IX (standard)	Ditto	8th March 1916	21st April 1916	30	32	68	16	Stands well and tillers fairly; trace of rust; grains red and hard.
IXA	Ditto	7th March 1916	Ditto	36	16	99	8	Tillers well; one-half crop fell flat; trace of rust; grains red.
IXB	Ditto	10th March 1916	23rd April 1916	28	32	89	8	Tillers well; whole crop fell flat; trace of rust; grains red and hard.
IXC	Ditto	29th February 1916	16th April 1916	36	32	74	16	Tillers well; whole crop slightly bent down; trace of rust; grains amber and hard of good shape and size.
XVIIA	Ditto	3rd March 1916	16th April 1916	30	32	66	0	Tillers well; whole crop bent down; trace of rust; grains red and hard of medium size; consistent in texture.
XVIIIB	Ditto	6th March 1916	12th April 1916	37	0	64	0	Stands and tillers well; trace of rust; grains red and hard.
XVIIIC	Ditto	8th March 1916	17th April 1916	37	8	89	8	Stands and tillers well; trace of rust; grains red and hard.
XVIIIA	Ditto	Ditto	Ditto	37	16	84	8	Stands and tillers well; trace of rust; grains amber and hard.
IX (standard)	Ditto	Ditto	21st April 1916	35	16	66	8	Stands and tillers well; trace of rust; sandy piece of land.
IXA	Ditto	4th March 1916	16th April 1916	32	0	69	8	Stands and tillers well; trace of rust; grains white and hard.
IXB	Ditto	6th March 1916	Ditto	18	0	38	0	Stands and tillers well; trace of rust; badly attacked by white ants; grains amber and hard.
IXC	Ditto	Ditto	13th April 1916	14	8	29	0	Stands and tillers well; trace of rust; badly attacked by white ants; grains white and hard.
IXD	Ditto	23rd February 1916	10th April 1916	20	8	51	32	Stands and tillers well; trace of rust; badly attacked by white ants; grains white and soft.
IXE	Ditto	7th March 1916	23rd April 1916	24	0	66	16	Stands and tillers well; trace of rust; badly attacked by white ants; grains white and soft.
XXIIIA	Ditto	6th March 1916	16th April 1916	36	0	79	8	Stands and tillers well; trace of rust; grains red and soft.
XXIYA	Ditto	4th March 1916	15th April 1916	33	8	76	16	Stands and tillers well; trace of rust; grains red and hard.
IX (standard)	Ditto	8th March 1916	21st April 1916	35	0	84	8	Stands and tillers well; trace of rust.
XXIIB	Ditto	6th March 1916	15th April 1916	28	16	70	16	Stands and tillers well; trace of rust; grains red and hard.
XXIYC	Ditto	Ditto	Ditto	32	32	75	8	Stands and tillers well; trace of rust; grains red and hard.

Statement A—concluded.

Type No.	Area in acres.	DATE OF			OUTTURN PER ACRE				REMARKS.
		Sowing.	Harvest.	Ripening.	Grain.		Bhusa.		
					Mounds.	Seers.	Mounds.	Seers.	
XXIVD	1/2	4th November 1915	7th March 1916	...	31	0	89	32	Stands and tillers well; trace of rust; grains very light red.
XXVA	1/2	Ditto	8th March 1916	...	25	8	62	32	Stands and tillers well; slightly attacked by white ants; trace of rust; grains white and hard.
XXVB	1/2	Ditto	Ditto	...	24	24	58	24	Stands and tillers well; slightly attacked by white ants; trace of rust; grains white and hard.
XXVC	1/2	12th November 1915	10th March 1916	...	24	18	46	0	Stands and tillers fairly; two-third crop badly attacked by white ants; trace of rust; grains red and hard.
XIXA	1/2	Ditto	7th March 1916	...	17	24	39	8	Tillers fairly; one-third crop fell flat; two-third crop badly attacked by white ants; trace of rust; grains white and hard.
XIXB	1/2	Ditto	8th March 1916	...	26	0	60	16	Tillers fairly; one-third crop fell flat; two-third crop badly attacked by white ants; trace of rust; grains white and hard.
XIXC	1/2	Ditto	Ditto	...	26	0	72	0	Tillers fairly; one-third crop fell flat; two-third crop badly attacked by white ants; trace of rust; grains red and hard.
XIXD	1/2	Ditto	7th March 1916	...	25	24	63	8	Tillers fairly; one-tenth crop fell flat; two-third crop badly attacked by white ants; trace of rust; grains red and hard.
IX (standard)	1/2	Ditto	9th March 1916	...	21	20	55	12	Stands and tillers well; two-third crop badly attacked by white ants; trace of rust.
XIXE	1/2	Ditto	11th March 1916	...	21	8	58	32	Stands and tillers well; two-third crop badly attacked by white ants; trace of rust; grains red and hard.
XIXF	1/2	Ditto	Ditto	...	28	32	57	24	Stands and tillers well; one-fourth crop badly attacked by white ants; trace of rust; grains amber and fairly hard.
XIXG	1/2	Ditto	9th March 1916	...	30	0	62	0	Stands and tillers well; slightly attacked by white ants; trace of rust; grains amber and hard.
XIXH	1/2	Ditto	Ditto	...	31	24	58	32	Stands and tillers well; slightly attacked by white ants; trace of rust; grains amber and hard.
XIXI	1/2	Ditto	10th March 1916	...	30	16	74	16	Tillers well; whole crop bent down; trace of rust; grains red and hard.
XIXJ	1/2	14th November 1915	11th March 1916	...	27	24	95	24	Stands and tillers well; trace of rust; grains red and hard.
XIXK	1/2	13th November 1915	10th March 1916	...	27	8	76	0	Tillers fairly; one-fifth crop fell flat; trace of rust; grains red and fairly hard.
XVIA	1/2	14th November 1915	8th March 1916	...	26	8	81	16	Tillers well; stands fairly; trace of rust; grains amber and hard.
VIIIC	1/2	15th November 1915	9th March 1916	...	29	0	74	8	Tillers well; one-eighth crop fell flat; trace of rust; grains amber and hard.

APPENDIX IV.

Report of the Assistant Professor of Entomology.

1. *The sugarcane moth-borer*.—A representative collection of the various species of moth-borers from canes, maize and sorghum has been reared and sent to Pusa for identification.

The cutting of "dead hearts" proves equally effective against all moth-borers which attack young canes.

2. *Cotton bollworm and its parasites (Rhogas Spp.)*.—Last season American cottons remained free from bollworm throughout. *Desi* cottons suffered from drought, and in October and November the bollworm attack in them appeared high on account of the scarcity of bolls. All cotton-growing districts were supplied with large quantities of Rhogas parasites by the beginning of August : but their further distribution was not carried out as efficiently as it might have been by the district revenue staff. This year a beginning is being made to have the parasite distributed where necessary by the agricultural staff. They will certainly do it more efficiently than the kanungos and patwaris to whom the work has generally been entrusted in the past.

3. *Mango-hoppers (Idiocerus Spp.) control experiments*.—The Hoshiarpur experiments gave the following results :—(i) Weekly spraying of the flowering shoots with crude oil emulsion before the opening of the flowers is successful. Smoking is also good but a little less effective. (ii) Both spraying or smoking should be continued till the end of May, as hoppers attack not only flowers but young fruits which fall off.

Spraying is expensive : each application costs two annas per tree. Hence, unless the fruit is specially valuable only smoking can be recommended and should be practised through.

4. *Mango mealy bugs (Monophlebus Stebbingi)*.—The experiment tried of tying a belt of cotton round the trunk of trees to prevent the ascent of these insects proved ineffective.

5. *Melon fly*.—During April and May the first attacked fruits were destroyed. The pest was thus kept down and the main crop was saved.

6. *Sericulture*.—Five hundred and seventy-five ounces of French silkworm seed were reared. Sheikh Ghulam Sadiq distributed 400 ozs. in Gurdaspur district and we gave 175 ozs. in Sialkot, Ambala, and Hoshiarpur districts : 565½ ozs. were reared by villagers and 9½ ozs. were distributed in small lots amongst 32 village primary schools.

The result of the rearings remained poor throughout as the seed was pebrinized ; consequently, the worms died towards maturity in large quantities : further, the season was generally unfavourable, for, on account of the failure of winter rains, the mulberries produced coarse leaves of poor nourishing qualities.

A total crop of 73 maunds 3 seers of dry cocoons was obtained, and this was sold for Rs. 5,087 at the exhibition held at Gurdaspur at the end of May.

I visited all the sericultural tracts and arrangements are in progress for starting mulberry nurseries for bush and tree plantations.

MADAN MOHAN LAL,

Assistant Professor of Entomology,

Punjab Agricultural College,

Lyalpur.

APPENDIX V.

Report of the Agricultural Engineer.

Introductory.—I remained in charge of the office of Agricultural Engineer to Government during the whole year 1915-16.

Well boring.—The establishment employed on this class of work consists of three supervisors and 20 borers, each borer having one mate to assist him. The object of the work is to increase the supply of water in ordinary wells. During the year a total of 346 wells were bored, this being an increase of 109 over the previous year's work. An increase of water was obtained in 288 of the wells bored, representing a percentage of success of $68\frac{1}{2}$ against $59\frac{1}{2}$ in the previous year.

Many of the failures are due to the fact that the well owners are unprepared to pay the cost of completing the work, and many of the so-called failures could be rendered successful by a somewhat deeper boring; further several failures are due to methods unsuitable to the sub-soil conditions. But during the latter half of the year a form of small strainer was employed in sub-soils unsuited for the plain pipe method, and these proved satisfactory. In 37 wells, borings were made in sub-soil which proved unsuitable for the plain pipe and strainers were used; only three of those failed and the remaining 34 were successful; of the three failures, two were due to inexperience in sinking and the third to faulty design. Considering that the new method of treating sub-soils previously considered unsuited to boring was only started during the latter half of the year, it is hoped that the percentage of successes may be further increased in the future; considerable trouble is however being experienced in obtaining the necessary material for this class of work on account of the war.

The demand for this class of boring is keen and the well owner is always willing to pay the cost of the work when it proves successful. Owing to the war, prices for pipes etc. have risen very considerably, but, in order to encourage the work, full market rates have not been charged to the well owner: increases in cost of material have been made cautiously and gradually and are not as rapid as the market rise, but it is hoped in time to recover full market value for the material used in this work.

Tube wells.—This class of work refers to borings from which large quantities of water are obtained by mechanical power. The necessary boring plant for this work was only received at the end of last September, and consequently little work has been done. Three tube well schemes have, however, been completed since the arrival of boring plant, the aggregate cost amounting to Rs. 15,000, and other schemes of this description are in progress. Many applications for tube well schemes are being received, and at the present time there is sufficient work to keep the present staff and boring apparatus employed for the next year. The total number of enquiries regarding this class of irrigation plant amounted to 81 during the past year and for these 75 detailed estimates and reports were prepared. In all, 12 of these estimates have been accepted and work will be carried out. Different sizes of tube well schemes are being installed in various places: the average installation put down is capable of irrigating three hundred acres a year, and so the ultimate advantage of this class of work is obvious.

Boring plant.—As stated in last year's report the 15-inch boring pipes were not expected to arrive in time for work during the year 1915-16, and as a matter of fact these pipes did arrive so late that it will be a few months yet before all necessary fittings, etc., are completed in order to permit of this plant being used. Owing to financial stringency no power boring plant has yet been obtained, but it is hoped to obtain some of the lighter varieties in the coming year. Until a heavy power boring plant is obtained artesian supplies cannot be exploited, nor can much development in ordinary tube well work be expected until the necessary plant is considerably increased.

Other works.—A type grain godown has been designed and is being erected in Montgomery district by private enterprise. An elevated grain bin of 500 maunds capacity has been designed and will shortly be erected for experimental purposes. In all about thirty designs have been prepared for various implements and machines connected with lift irrigation and agriculture and several of these are awaiting the erection of a workshop and necessary tools for their construction and trial.

Many schemes have been prepared for lift irrigation on a large scale, but so far none of these have materialised, and it is hoped that in the near future Government will be induced to finance a scheme which will show the financial advantage of dealing with lift irrigation on a comparatively large scale.

Work generally has been seriously handicapped during the past year both by the high prices of tools and plant, etc., and by the difficulty in obtaining materials: unfortunately these conditions are likely to affect the work of the coming year also.

T. A. MILLER BROWNLIE,

Agricultural Engineer to Government, Punjab.

Appendix A.

WELL BORING.

No.	Name of district.	WELLS.		REMARKS.
		Number of bores.	Successful.	
1	Gurgaon	54	44	} Rewari Circle. Owing to running sand the percentage of failures in this district is high at present.
2	Hissar	8	3	
3	Karnal	21	13	
4	Ambala	10	2	
		88	62	
5	Ludhiana	61	38	} Ludhiana Circle.
6	Ferozepore	34	28	
7	Montgomery	27	19	
8	Bahawalpur State	2	...	
		124	85	
9	Jullundur	32	18	} Jullundur Circle.
10	Hoshiarpur	47	31	
11	Gurdaspur	7	5	
12	Jhelum	3	1	
13	Mianwali	1	1	
14	Amritsar	15	15	
15	Sialkot	29	20	
		184	91	
	Total	346	238	68½ per cent., or say 69 per cent. success.

Appendix B.

TUBE WELLS COMPLETED.

1. District Gujranwala, village, Khaka, near Baloki. Owners—S. Nihal Singh and Jowahar Singh. For general crops irrigation capable of irrigating over 300 acres per annum.
2. District Lahore, Lawrence Gardens, Lahore. For garden irrigation—capable of yielding over 1 cusec.
3. District Amritsar, near city. Owners—Karoo Shah Behari Lal. For tobacco crop chiefly—capable of irrigating over 300 acres per annum.

APPENDIX VI.

Report of the Professor of Agriculture on the Lyallpur Farm.

1. *Introductory*.—I took over charge on April 28th from Mr. Roberts who proceeded on combined leave on that date.

2. *The season*.—This has been a year of very deficient rainfall; the total for the year amounted to only 3.04 inches as compared with 21.05 inches in the previous year. The average rainfall for the periods of five and ten years previous has been 14.98 and 15.32, respectively. The very hot dry weather from August to November 1915 did not conduce to a high yield of cotton; desi cotton suffered more than American. The dry winter was by no means unfavourable to wheat (except where the cultivation and irrigation were both insufficient); such rain as fell came at timely intervals. Rust this year did exceptionally little damage, and the grain matured well with a minimum of that shrivelling which is usually ascribed to hot dry winds in April. Maize did very well this year, and toria yielded an average crop, which fetched a fair price; for sugarcane the season was unfavourably dry. In general the season has thus been a favourable one for irrigated land such as that on the Lyallpur Farm.

3. *Experiments at the farm*.—(a) Sugarcane, maize and cotton.

Manurial experiment.—For full details see report for the year 1911-12 where the experiment was fully described. This year's results are given in statements 2, 3 and 4.

(b) *Manurial experiments with sugarcane, maize and cotton in the kharif series and gram, wheat and toria in the rabi*.—See 1911-12 Report for details, and statements 5 to 10 for this year's results.

Toria in square 26 (statement No. 11).—These results are very interesting as repeatedly giving evidence of the reliability of the land used in different years for the two following experiments:—

Spacing experiment with 4 F. cotton (square 26).—See statement No. 12.

Wheat varietal tests with Punjab types 11 and 17 and Pusa 12.—See statements Nos. 13 (a) and 13 (b). The results agree remarkably with those of the last year, and in view of the fact that the experiment each year comes in rotation into different plots, are extremely interesting. The following is a summary of the last three years' figures:—

		1913-14.		1914-15.		1915-16.	
		Mds. Srs.		Mds. Srs.		Mds. Srs.	
		<i>After cotton.</i>					
Punjab 11 ...	...	21	25	21	12	28	30
Punjab 17 ...	...	17	22	20	27	28	22
Pusa 12 ...	...	18	16	20	5	26	20
		<i>After wheat.</i>					
Punjab 11 ...	...	14	23	18	35	22	3
Punjab 17 ...	...	14	36	17	37	18	33
Pusa 12 ...	...	17	32	19	0	22	7

After wheat Pusa 12 does as well as, or slightly better than, Punjab 11, and better than Punjab 17, but after cotton the Punjab wheats do better.

In the tests on the tenants' area, where the conditions as to cultivation, etc., are not quite so favourable, but resemble more those prevailing on ordinary zamindars' land, Pusa 12 gives a less yield per acre than either of the Punjab wheats, as may be seen from the following figures:—

		Number of tests.		Total area.		Average yield per acre.	
				K. M.		Mds. Srs.	
Punjab 11 } ...	...	10		{ 41	10	20	6
Pusa 12 }	...			{ 41	11	18	31
Punjab 17 } ...	...	4		{ 16	5	17	23
Pusa 12 }	...			{ 16	8	15	35

Pusa 12 did better than Punjab 11 in only three of the tests; and better than Punjab 17 in only one case.

In the comparative tests between Punjab types 11 and 17 under the same conditions, Punjab 11 does distinctly better than Punjab 17:—

	Number of tests.	Total area.	Average yield	
			K. M.	Mds. Srs.
Punjab 11 }	10 {	36 16	17	22
Punjab 17 }			15	3

Punjab 17 did better in only one of the tests.

The corresponding figures last year were as follows:—

	Number of tests.	Yield.
		Mds. Srs.
Punjab 11 }	11 {	15 10
Pusa 12 }		13 31
Punjab 11 }	11 {	11 6
Punjab 17 }		10 10

Pusa 12 did better than Punjab 11 in only two of the tests and Punjab 17 did better in four cases.

Note.—This average is lowered by one plot, badly affected by kallar, which gave only 4 maunds and 15 seers.

The characters of the wheat seasons of 1914-15 and 1915-16 were in many respects markedly different. 1914-15 was a year when rust and also shrivelling of grain were rather bad and yields were not high. 1915-16 was on the whole a good year for wheat grown under such conditions as prevail at our farm, and the tests are conducted on different plots each year, yet the annual results of these varietal tests are in almost striking conformity; this year's figures confirm those of last year, and emphasise the remarks made about these wheats in last year's report. The gist of these remarks was that these two beardless wheats, Pusa 12 and Punjab 17, give distinctly less yield than Punjab 11 under ordinary conditions. Only under certain conditions as to land cultivation and irrigation the beardless wheats may yield as well as Punjab 11. But under such conditions as prevail on our tenants' land they give a yield inferior to that of Punjab 11. And this inferiority is such that not only would Pusa 12 and Punjab 17 be less profitable under the prevailing conditions of our wheat trade, but they must remain so, unless and until these wheats of superior milling and baking properties command a very much better price per maund than Punjab 11. As yet this is not the case.

On the strength of these results we are continuing our present policy of distributing in the districts mainly Punjab type No. 11. More extensive tests of Pusa 12 as against Punjab 17 will be made next year: the tests of these two varieties against Punjab 11 will be discontinued.

Varietal tests of wheat have now been carried out on a considerable scale at Lyallpur for many years and in a great majority of the tests Punjab 11 has appeared to be the best yielding and most reliable of the commoner Punjab wheats. This is confirmed by our wheat surveys and our experience since this wheat was distributed in a pure state in the district, where it is now grown pure on a large and rapidly increasing scale. But we are continually testing new varieties, and there is not the slightest reason to suppose that Punjab 11 is the last word in wheat seed for these canal colonies. On the contrary, we hope it will be possible greatly to improve upon it. For the present however it has proved its all-round suitability for this tract, and the superiority of another wheat must be thoroughly proved before Punjab 11 can be displaced.

Wheats handed over recently by Economic Botanist.—Three wheats, 8-A, 8-B and 17-B, have been subjected to preliminary tests against Punjab 11. The results may be summarised as follows:—

Type No.	Number tests.	Total of area of each type.		Total outturn of each type.		Outturn per acre.	
		K.	M.	Mds.	Srs.	Mds.	Srs.
8-A	2 {	7	18	16	28	16	31
		7	18	15	36	16	4
8-B	2 {	8	0	26	21	26	21
		8	0	21	19	21	19
17-B	3 {	11	7	33	17	23	22
		11	9	31	33	21	35

No. 8-A gave a better yield than No. 11 in one test, less in the other where it was affected by kallar. No. 8-B did better than 11 in one plot, worse in the other. No. 17-B did better than 11 in each test. Nos. 8-A and 8-B are bearded wheats which appears to have strong white grain, and their figures as to yield compared to No. 11 are encouraging. These two varieties will, therefore, be further tested next year. No. 17-B, although it has yielded slightly better than No. 11, has a beardless ear and red grain. Therefore, since it will be impossible to test more than two of these varieties thoroughly this year, No. 17-B will not be grown under test conditions this year.

Cottons handed over recently by Economic Botanist.—The results are recorded in statement 14. But it is not considered desirable to offer any comment on this subject at present. The varieties are being further tested this year; and it is hoped that it will be possible to make a fuller report on this subject next year.

Sugarcane variety experiment.—See statement No. 15.

Dhau was rejected last year as not being sufficiently hardy for this tract. Kansar is being tried in its stead.

Hydraulic experiments.—See statements Nos. 16 (a) and 16 (b). The experiment has been so recently started that it is not desirable at this stage to attempt to draw elaborate conclusions, but the yields, both absolute and relative, of the various plots are interesting. With regard to the former, it may be pointed out that on one plot a yield of wheat corresponding to 33½ maunds per acre has been obtained with a total depth of irrigation (including that before sowing) of less than 13 inches, and a rainfall during the four months before sowing of little more than 1·6 inches; as well as about one inch after sowing. It is suggested that these figures will compare, not unfavourably, with dry farming records in any part of the world.

The relative yields of the various plots appear to demonstrate the value of harrowing the growing crop; and also to suggest that, for the ordinary methods of irrigating with canal water in the colony, the practice of making eight kharis per acre is not far wrong.

The results so far obtained need confirmation in future years before reliable conclusions can be drawn.

Manuring experiments with calcium nitrate on wheat.—See statement No. 17.

There are marked increases resulting from the application of the manure, but they are obtained at a cost which renders them barely profitable.

Hot weather compared to monsoon ploughing for wheat.—See statement No. 18.

No rains fell sufficient for ploughing this hard land, so that the so-called "rains-ploughing" was carried out after irrigation in September, and, as might be expected in these circumstances, markedly beneficial results accrued from the hot weather ploughing. The year was exceptional and the experiment could not be conducted in the usual way, so that the results are not comparable to those of former years.

Miscellaneous experiments.—A large number of other experiments have been carried out; none of which appear to be of sufficiently general interest to merit report here except the following:—

Experiments with mangel warzels.—See statement No. 19. This year's trials with mangel warzels are distinctly encouraging. The crop becomes available at a time when green fodder is scarce (April-May); and very good yields have been obtained. Two plots, each about ½ acre in area, give yields corresponding to over 1,000 maunds of roots per acre. This yield would not be considered bad under ordinary conditions in any part of England. Long Reds appear to be much the more suitable variety of those yet tried; but others will be tried in future. The quantity of water used in growing this crop was extremely heavy, but it is hoped that means may be found of remedying this to some extent.

Manurial experiments with bone meal and gypsum on wheat and toria.—See statements Nos. 20 (a) and 20 (b). These experiments are of interest in view of the attention which has lately been drawn to the export of bones from India. Bone meal shews practically no effect on either crop; gypsum has apparently caused a slight increase in the wheat crop. This may be seen from the following summary which gives the average outturns of grain per acre of the various plots.

<i>Toria.</i> —Unmanured	...	...	11 maunds and 30 seers.
Manured with bone meal	...	...	11 maunds and 27 seers.
Manured with gypsum	...	...	11 maunds and 15 seers.
<i>Wheat.</i> —Unmanured	...	...	24 maunds and 13 seers.
Manured with bone meal	...	...	24 maunds and 34 seers.
Manured with gypsum	...	...	26 maunds and 25 seers.*

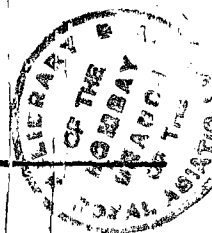
The residual effects of these manures on the succeeding crop will be noted this year (1916-17), and the experiment is to be expanded and repeated in another part of the tenant's area.

O. T. FAULKNER,

Offg. Professor of Agriculture, Punjab, Lyallpur.

The 8th August 1916.

1	2	3
Name of month.	Rainfall during 1915-18.	Rainfall during 1914-15.
June	.89	1.66
July	.26	8.18
August	.47	3.95
September	...	1.70
October	...	2.33
November	...	.07
December	.41	.17
January	...	...
February	.47	.32
March	.13	1.91
April	.17	.76
May	.25	...
Total	3.04	21.05



No. of square.	No. of plot.	AREA.		Name of variety.	Treatment.	WEIGHT OF GREEN TOPS.		WEIGHT OF CANE.		WEIGHT OF JUICE.		WEIGHT OF GUR.		WEIGHT OF GUR PER ACRE.		Percentage of green tops to cane.	Percentage of juice to cane.	Percentage of gur to juice.	Percentage of gur to cane.	REMARKS.
		Kanals.	Masals.			Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.							
27 C.	1	4	0	Katiba.	Castor cake at 10½ cwt. per acre.	107	18	121	24	59	13	11	3	22	7	88.36	48.78	18.6	9.1	Ploughing ... 4
	2	4	0		Ditto.	102	8	115	33	57	38	10	29	21	19	88.2	50.03	18.5	9.3	Harrowing ... 12
	3	4	0		Castor cake at 10½ cwt. per acre, and calcium nitrate at 65 lbs. nitrogen per acre.	136	20	152	6	70	16	14	27	29	14	89.8	52.2	18.5	9.6	Sohagaing and weeding ... 12
	4	4	0		Castor cake at 10½ cwt. per acre and crude nitre at 65 lbs. nitrogen per acre.	143	21	135	24	74	0	12	23	25	16	105.8	54.5	17.1	9.3	Hoeing ... 6
																				Watering ... 18
																				Date of sowing, 28th March 1915.
																				Crushing began on 24th January 1916 and finished on 4th February 1916.

Statement No. 3

SHOWING THE OUTTURN OF MAIZE GROWN IN THE MANURIAL AND ROTATIONAL SERIES IN KHARIF 1915.

No. of square.	No. of plot.	Name of variety.	Treatment.	AREA.		WEIGHT OF DRY STALKS.		WEIGHT OF DRY CDS.		WEIGHT OF GRAIN.		YIELD PER ACRE.		REMARKS.
				Kanals.	Marias.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
27 G.	1	Red local maize.	Residue of farm yard manure at 15 tons per acre + residue of potassium nitrate containing 65 lbs. nitrogen per acre.	4	0	11	18	10	5	8	12	16	24	Ploughing ... 6 Harrowing ... 14 Sohagaing ... 14
	2		Residue of farm yard manure at 15 tons per acre + residue of calcium nitrate containing 65 lbs. nitrogen per acre.	4	0	15	37	15	26	13	5	28	10	Hoeing ... 6 Watering ... 6 Date of sowing, 2nd August 1915.
	3		Residue of farm yard manure at 15 tons per acre.	4	0	19	28	17	29	14	28	29	17	Date of harvesting, 23rd November 1915.
	4		Ditto	4	0	14	36	14	13	11	36	23	32	

Statement No. 4

SHOWING THE RESULTS OF RESIDUAL EFFECT OF MANURE ON FARM SELECTED BROAD-LEAVED COTTON GROWN IN THE MANURIAL AND ROTATIONAL SERIES IN KHARIF 1915.

No. of square.	No. of plot.	AREA.		Variety.	Treatment.	ACTUAL OUTTURN.		OUTTURN PER ACRE.		REMARKS.
		Kanals.	Marias.			Maunds.	Seers.	Maunds.	Seers.	
27 G.	1	4	0	Farm selected broad-leaved.	Residue of green manuring with senji	3	4	6	9	Ploughing ... 3 Harrowing ... 11 Sohagaing ... 9
	2	4	0		Ditto ditto	5	6	10	13	Hoeing and weeding ... 5 Watering ... 7
	3	4	0		Residue of green manuring with senji + residue of calcium nitrate containing 65 lbs. nitrogen per acre.	5	25	11	10	Date of sowing, 14th and 15th April 1915.
	4	4	0		Residue of green manuring with senji + residue of potassium nitrate containing 65 lbs. nitrogen per acre.	1	31	3	23	Picking began on 8th September 1915 and finished on 20th January 1916.

Statement No. 5

SHOWING THE OUTTURN OF SUGARCANE GROWN IN THE MANURIAL BLOCK AREA D, STANDARD K,
SQUARE 27, IN KHARIF 1915.

No. of square.	No. of plot.	Name of variety.	Treatment.	Area in acres.	WEIGHT OF GREEN TOPS.		WEIGHT OF CANE.		WEIGHT OF JUICE.		WEIGHT OF GUR.		YIELD OF GUR PER ACRE.		Percentage of green tops to cane.	Percentage of juice to cane.	Percentage of gur to juice.	Percentage of gur to cane.	REMARKS.
					Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.					
27	12	Kotha.	Unmanured ...	$\frac{37}{1330}$	4	39	5	18	2	27	0	21	13	38	91.3	49.08	19.8	9.7	Ploughing ... 3
	13		Calcium cyanide at 3 cwts. and 60.7 lbs. per acre.	$\frac{1}{4}$	42	32	59	13	32	5	6	9	31	7	72.1	54.1	19.4	10.5	Harrowing ... 11 Sohagaing ... 14
	14		Unmanured ...	$\frac{37}{880}$	8	16	12	30	6	37	1	13	23	25	65.8	54.3	19.1	10.4	Hoeing ... 4
	15		Calcium nitrate at 4 cwts. and 110.6 lbs. per acre.	$\frac{1}{4}$	44	18	69	9	39	11	7	5	35	25	84.2	56.7	18.1	10.2	Watering ... 21
	16		Unmanured ...	$\frac{37}{880}$	10	2	16	29	8	11	1	28	30	21	60.08	49.4	20.7	10.2	Date of sowing, 27th March 1915.
	17		Farm yard manure at 4 tons per acre.	$\frac{1}{4}$	39	18	59	26	31	0	6	15	31	35	66.1	51.9	20.5	10.6	Crushing began on 14th January 1916 and finished on 21st January 1916.
	18		Unmanured ...	$\frac{1}{4}$	8	5	11	7	5	13	1	2	14	24	72.7	47.6	19.9	9.5	
	19		Ammonium sulphate at 3 cwts. and 4 lbs. per acre.	$\frac{1}{4}$	56	7	82	19	41	35	8	12	41	20	68.1	50.9	19.8	10.06	
	20		Unmanured ...	$\frac{37}{880}$	10	20	12	22	6	5	1	12	23	7	83.6	48.8	21.2	10.3	
	21		Gypsum at 5 cwts. per acre.	$\frac{1}{4}$	36	26	37	39	15	31	3	21	17	28	96.5	41.5	22.4	9.3	
22	Unmanured ...	$\frac{37}{1330}$	5	6	2	23	1	5	0	8	7	14	20.0	43.5	18.3	8.0			

Statement No. 6

SHOWING THE OUTTURN OF MAIZE GROWN AT THE MANURIAL BLOCK AREA D, SQUARE 27, IN KHARIF 1915.

No. of square.	No. of plot.	Name of variety.	Treatment.	Area in acres.	WEIGHT OF DRY STALKS.		WEIGHT OF FRESH COBS.		WEIGHT OF DRY COBS.		WEIGHT OF GRAIN.		YIELD PER ACRE.		REMARKS.
					Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
27	23	Red local maize.	Unmanured ...	$\frac{37}{1330}$	0	23	0	28	0	20	0	16	14	37	Ploughing ... 7
	24		Bone meal at 2 cwts. and 80 lbs. per acre + lime at 5 cwts. per acre.	$\frac{1}{4}$	6	23	8	11	6	4	5	0	25	3	Harrowing ... 13
	25		Unmanured ...	$\frac{37}{880}$	1	23	1	30	1	13	1	3	19	11	Sohagaing ... 15
	26		Lime at 5 cwts. per acre + ammonium sulphate at 3 cwts. and 4 lbs. per acre.	$\frac{1}{4}$	6	7	8	0	.5	31	4	27	23	15	Hoeing and weeding 6
	27		Unmanured ...	$\frac{37}{880}$	1	15	1	17	1	6	0	38	17	2	Watering ... 6
	28		Farm yard manure at 4 tons per acre.	$\frac{1}{4}$	7	9	7	17	5	21	4	18	22	13	Date of sowing, 10th August 1915.
	29		Unmanured ...	$\frac{37}{880}$	1	24	1	26	1	13	1	4	19	24	Date of harvesting, 23rd November 1915.
	30		Bone meal at 2 cwts. and 80 lbs. per acre + lime at 5 cwts. per acre + ammonium sulphate at 3 cwts. and 4 lbs. per acre.	$\frac{1}{4}$	7	18	8	28	6	17	5	10	26	10	
	31		Unmanured ...	$\frac{37}{880}$	1	18	1	21	1	8	0	39	17	31	
	32		Superphosphate at 231 lbs. per acre + calcium nitrate at 4 cwts. and 110.6 lbs. per acre + ammonium sulphate at 3 cwts. and 4 lbs. per acre.	$\frac{1}{4}$	9	16	8	17	6	28	5	15	26	37	
	33		Unmanured ...	$\frac{37}{880}$	2	1	2	5	1	21	1	10	22	16	

Statement No. 7

SHOWING THE OUTTURN OF COTTON GROWN IN THE MANURIAL BLOCK STANDARD KHARIF
AREA D, SQUARE 27.

No. of square.	No. of plot.	Name of variety.	Treatment.	Area in acres.	ACTUAL OUTTURN.		OUTTURN PER ACRE.		REMARKS.
					Maunds.	Seers.	Maunds.	Seers.	
27	1	Farm selected broad-leaved cotton.	Unmanured ...	$\frac{10873}{528000}$	0	3	3	28	Ploughing ... 3
	2		Superphosphate at 231 lbs. per acre...	$\frac{5}{32}$	0	34	5	19	Harrowing ... 11
	3		Unmanured ...	$\frac{1133}{56400}$	0	15	8	24	Sohagaing ... 11
	4		Bone meal at 2 cwts. and 80 lbs. per acre	$\frac{143}{800}$	1	19	8	10	Hoeing ... 8
	5		Unmanured ...	$\frac{248}{5280}$	0	18	9	6	Watering ... 11
	6		Farm yard manure at 4 tons per acre.	$\frac{132}{800}$	1	15	7	38	Date of sowing, 11th April 1915.
	7		Unmanured ...	$\frac{27}{800}$	0	18	8	8	Picking began on 25th October 1915 and finished on 21st January 1916.
	8		Basic slag at 8 maunds per acre	$\frac{1}{8}$	1	31	8	37	
	9		Unmanured ...	$\frac{27}{800}$	0	17	7	27	
	10		Lime at 5 cwts. per acre	$\frac{1}{8}$	1	1	5	5	
	11		Unmanured ...	$\frac{27}{1280}$	0	3	2	33	

Statement No. 8

SHOWING THE OUTTURN OF TORIA GROWN IN THE MANURIAL BLOCK AREA, SQUARE 29,
IN RABI 1915-16.

No. of square.	No. of plot.	Name of crop.	Treatment.	Area in acres.	GRAIN.		STRAW.		YIELD OF GRAIN PER ACRE.		REMARKS.
					Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
27	1	Torja.	Unmanured ...	$\frac{37}{1280}$	0	5	0	15	5	5	Ploughing ... 2
	2		Superphosphate at 231 lbs. per acre.	$\frac{1}{8}$	2	7	7	8	10	35	Harrowing ... 7
	3		Unmanured ...	$\frac{27}{800}$	0	16	1	15	7	9	Sohagaing ... 3
	4		Bone meal at 2 cwt. and 80 lb. per acre.	$\frac{1}{8}$	1	38	6	26	9	32	Watering ... 2
	5		Unmanured ...	$\frac{27}{800}$	0	16	1	24	7	12	Date of sowing, 14th September 1915.
	6		Farm yard manure at 4 tons per acre.	$\frac{1}{8}$	2	15	6	33	11	35	Date of harvesting, 18th January 1916 to 1st February 1916.
	7		Unmanured ...	$\frac{27}{800}$	0	17	1	9	7	23	
	8		Basic slag at 8 maunds per acre.	$\frac{1}{8}$	1	34	5	18	9	10	
	9		Unmanured ...	$\frac{27}{800}$	0	15	1	5	6	27	
	10		Lime at 5 cwts. per acre	$\frac{1}{8}$	1	3	4	18	5	17	
	11		Unmanured ...	$\frac{27}{1280}$	0	5	0	18	7	7	

Statement No. 9

SHOWING THE OUTTURN OF GRAM GROWN IN THE SECOND MANURIAL SERIES IN RABI 1915-16.

No. of square.	No. of plot.	Name of crop.	Treatment.	Area in acres.	ACTUAL OUTTURN.				OUTTURN PER ACRE.				REMARKS.
					Grain.		Bhusa.		Grain.		Bhusa.		
					Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
D 27— R	12	Local gram.	Unmanured ...	$\frac{1}{1335}$	0	18	0	24	16	2	21	16	
	13		Calcium cyanamide at 3 cwt. and 60·7 lbs. per acre.	$\frac{1}{4}$	4	14	5	0	21	32	25	0	Ploughing ... 2
	14		Unmanured ...	$\frac{2}{550}$	1	4	2	10	19	38	40	5	Harrowing ... 19
	15		Calcium nitrate at 6 cwt. and 34·62 lbs. per acre.	$\frac{1}{4}$	4	29	4	25	23	25	23	5	Sohagaing ... 11
	16		Unmanured ...	$\frac{3}{550}$	1	11	1	28	22	34	30	12	Watering ... 4
	17		Farm yard manure at 4 tons per acre.	$\frac{1}{4}$	4	16	4	38	22	2	23	30	Hoeing ... 3
	18		Unmanured ...	$\frac{1}{11}$	0	24	0	24	8	16	8	10	Date of sowing, 6th October 1915.
	19		Ammonium sulphate at 340 lbs. per acre.	$\frac{1}{4}$	4	1	3	32	20	5	19	0	Date of harvesting, 17th April 1916.
	20		Unmanured ...	$\frac{2}{550}$	1	7	1	10	21	11	22	11	
	21		Gypsum at 560 lbs. per acre.	$\frac{1}{4}$	4	5	3	5	20	25	15	25	
	22		Unmanured ...	$\frac{3}{1335}$	0	8	0	10	7	5	8	36	

Statement No. 10

SHOWING THE OUTTURN OF WHEAT GROWN IN THE SECOND MANURIAL SERIES IN RABI 1915-16.

No. of square.	No. of plot.	Name of crop.	Treatment.	Area in acres.	ACTUAL OUTTURN.				OUTTURN PER ACRE.				REMARKS.
					Grain.		Bhusa.		Grain.		Bhusa.		
					Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
D 27— R	23	Wheat type No. 9.	Unmanured ...	$\frac{2}{1335}$	0	20	1	1	18	11	37	0	Germination good; crop uniform; well standing; height 4 feet to 4 feet 2 inches.
	24		Bone meal at 304 lbs. per acre + lime at 560 lbs. per acre.	$\frac{1}{4}$	5	0	11	21	25	3	57	26	Germination good; crop uniform; well standing; growth vigorous; height 4 feet to 4 feet 4 inches.
	25		Unmanured ...	$\frac{2}{550}$	1	8	2	19	21	16	44	5	Ditto ditto.
	26		Lime at 560 lbs. per acre + ammonium sulphate at 340 lbs. per acre.	$\frac{1}{4}$	5	14	13	33	26	30	69	5	Germination good; growth excellent; height 4 feet to 4½ feet.
	27		Unmanured ...	$\frac{2}{550}$	1	11	2	39	22	29	53	2	Crop uniform.
	28		Farm yard manure at 4 tons per acre.	$\frac{1}{4}$	5	11	12	2	26	17	60	12	Lodging 15 per cent.; good crop; height 4 feet to 4½ feet.
	29		Unmanured ...	$\frac{2}{550}$	1	9	3	15	21	34	60	8	Lodging 10 per cent.; crop fair.
	30		Bone meal at 304 lbs. per acre + lime at 560 lbs. per acre and ammonium sulphate at 340 lbs. per acre.	$\frac{1}{4}$	5	2	15	4	25	11	75	23	Germination good; lodging 50 per cent.; growth heavy; irregular in ripening; height 4½ feet.
	31		Unmanured ...	$\frac{2}{550}$	1	7	3	18	20	38	61	21	Lodging 30 per cent.
	32		Superphosphate at 231 lbs. per acre + calcium nitrate at 706·62 lbs. per acre + ammonium sulphate at 340 lbs. per acre.	$\frac{1}{4}$	4	29	15	27	23	25	78	15	Lodging 60 per cent.; germination good, growth heavy; irregular in ripening; height 4½ feet.
	33		Unmanured ...	$\frac{2}{550}$	1	15	4	16	24	21	78	19	Lodging 12 per cent.

Ploughing ... 2
Harrowing ... 7
Sohagaing ... 5
Hoeing ... 4

Watering ... 5
Date of sowing, 25th October 1915.
Date of harvesting, 27th April 1916 to 29th April 1916.

Statement No. 11

SHOWING THE OUTTURN OF TORIA (SEEDS AND STRAW) GROWN IN SQUARE 26 IN RABI 1915-16.

No. of square.	Name of plot.	Name of crop.	Previous crop.	Area in acres.	GRAIN.		STRAW.		YIELD OF GRAIN PER ACRE.		REMARKS.
					Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
26 A-4	1-A	...	...	$\frac{1}{2}$	3	28	9	20	7	16	Ploughing ... 1
	1-B	Toria	Wheat	$\frac{1}{2}$	5	27	14	24	11	14	Harrowing ... 5
	2-A	Do.	Do.	$\frac{1}{2}$	3	35	9	15	7	30	Sohagaing ... 2
	2-B	Do.	Do.	$\frac{1}{2}$	4	21	11	38	9	3	Watering ... 4
	3-A	Do.	Do.	$\frac{1}{2}$	3	21	9	11	7	3	Date of sowing, 14th September 1916.
	3-B	Do.	Do.	$\frac{1}{2}$	5	10	13	7	10	20	Date of harvesting, 5th January 1916 to 3rd February 1916.

Statement No. 12

SPACING EXPERIMENT WITH 4 F. COTTON IN SQUARE 26 IN 1915 16.

No. of square.	No. of plot.	Name of variety.	Previous crop.	Area in acres.	ACTUAL OUTTURN.		OUTTURN PER ACRE.		REMARKS.
					Maunds.	Seers.	Maunds.	Seers.	
26 A-3	1-A	...	...	$\frac{13}{20}$	2	27	8	9	$\frac{3}{4}$ rd of the usual distance, e.g., 2 feet.
	1-B	...	...	$\frac{1}{2}$	5	35	11	30	Ditto ditto.
	2-A	Cotton 4 F.	Toria	$\frac{13}{180}$	1	33	6	34	Usual distance, e.g., 3 feet.
	2-B	Ditto	Do.	$\frac{1}{2}$	4	27	9	14	Ditto ditto.
	3-A	Ditto	Do.	$\frac{13}{180}$	3	13	7	13	$1\frac{1}{2}$ times the usual distance, e.g., $4\frac{1}{2}$ feet.
	3-B	Ditto	Do.	$\frac{1}{2}$	4	27	9	15	Ditto ditto.

Ploughing

Harrowing

Sohagaing

Hoeing

Watering

Date of sowing, 13th and 14th April 1915.

Picking began on 3rd November 1915 and finished on 22nd January 1916.

Statement No. 13 (a)

SHOWING THE COMPARATIVE TEST OF WHEAT TYPES 11, 17 AND PUSA 12 AT THE AGRICULTURAL STATION, LYALLPUR, RABI 1915-16.

No. of square.	No. of plot.	Area in acres.	Name of type.	ACTUAL OUTTURN.				OUTTURN PER ACRE.				Previous crop.	REMARKS.
				Grain.		Bhusa.		Grain.		Bhusa.			
				Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.		
26	A —1 a 2	1/2	Pusa 12 ...	14	1	26	8	28	2	52	16	Cotton ...	Germination good; growth uniform; early; lodging 85 per cent.
	A —1 b 2	1/2	Ditto ...	12	19	22	2	24	38	44	4	Do. ...	Germination good; growth uniform; crop thin; early; lodging 50 per cent.
	A —2 a 2	1/2	Punjab 11...	13	33	23	31	27	26	47	22	Do. ...	Germination good; growth uniform; lodging 9 per cent.
	A —2 b 2	1/2	Ditto ...	14	37	25	37	29	34	51	34	Do. ...	Germination good; growth uniform; lodging 4 per cent.
	A —3 a 2	1/2	Punjab 17...	13	4	24	34	26	8	49	28	Do. ...	Germination good; growth uniform; lodging 17 per cent.
	A —3 b 2	1/2	Ditto ...	15	18	30	25	30	36	61	10	Do. ...	Germination good; growth uniform; lodging 48 per cent.

Ploughing ... 5
 Harrowing ... 17
 Sohagaing ... 10
 Watering ... 5
 Hoeing and weeding ... 6
 Date of sowing, 24th October 1916.
 Date of harvesting, 15th April to 19th April 1916.

Statement No. 13 (b)

SHOWING THE COMPARATIVE TEST OF WHEAT TYPE 11, 17 AND PUSA 12 AT THE LYALLPUR AGRICULTURAL STATION, RABI 1915-16.

No. of square.	No. of plot.	Area in acres.	Name of type.	ACTUAL OUTTURN.				OUTTURN PER ACRE.				Previous crop.	REMARKS.
				Grain.		Bhusa.		Grain.		Bhusa.			
				Maunds.*	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.		
26	A —1 a 1 A	1/2	Pusa 12 ...	10	38	22	18	21	36	44	36	Wheat ...	Germination good; growth uniform; early; lodging 15 per cent.
	A —1 b 1 A	1/2	Ditto ...	11	9	21	35	22	18	43	30	Do. ...	Germination good; growth uniform; early; lodging 17.5 per cent.
	A —2 a 1 A	1/2	Punjab 11...	10	25	20	12	21	10	40	24	Do. ...	Germination good; growth uniform; crop standing.
	A —2 b 1 A	1/2	Ditto ...	11	18	21	35	22	36	43	30	Do. ...	Ditto.
	A —3 a 1 A	1/2	Punjab 17...	8	38	18	0	17	37	36	0	Do. ...	Ditto.
	A —3 b 1	1/2	Ditto ...	9	34	19	3	19	29	38	6	Do. ...	Ditto.

Ploughing ... 4
 Harrowing ... 5
 Sohagaing ... 5
 Hoeing and weeding ... 6
 Watering ... 4
 Date of sowing, 24th October 1915.
 Date of harvesting, 15th April 1916.

Statement No. 14

SHOWING THE YIELD OF COTTON TESTED ON TENANTS' AREA IN KHARIF 1915.

Serial No.	Name of variety.						AREA.		ACTUAL OUTTURN.		OUTTURN PER ACRE.		Year of handing over to Lyallpur Agricultural Station.	REMARKS.
							Kanals.	Masals.	Maunds.	Seers.	Maunds.	Seers.		
1	4 F.	...	...	...	...	...	12	12	7	39	5	2	1910	
2	266 F.	...	...	...	...	...	12	2	6	39	4	24	1913	
3	4 F.	...	...	...	...	...	9	0	5	14	4	30	1910	
4	275 F.	...	...	...	...	...	9	10	5	27	4	31	1913	
5	4 F.	...	...	...	...	...	6	18	7	11	8	18	1910	
6	280 F.	...	...	...	...	...	7	3	9	3	10	6	1913	
7	G. Neglectum rosea, No. 87	...	...	...	...	...	5	5	5	33	8	35	1914	
8	G. Indicum, No. 135-A...	...	...	...	...	...	7	15	4	30	4	37	1914	
9	G. Neglectum rosea, No. 87	...	...	...	...	...	8	10	7	5	6	29	1914	
10	G. Sangunum, broad leaf, No. 20-A.	...	...	...	...	...	9	16	4	38	4	2	1914	
11	G. Neglectum, rosea, No. 87	...	...	...	...	...	6	0	5	11	7	2	1914	
12	G. Indicum mollisonea, No. 24	...	...	...	...	...	7	8	4	7	4	20	1914	
13	G. Neglectum rosea, No. 87	...	...	...	...	...	2	10	1	33	5	34	1914	
14	G. Neglectum, No. 40	...	...	...	...	...	2	4	0	37	3	14	1915	

Statement No. 15.

SHOWING THE RESULT OF VARIETY EXPERIMENT WITH SUGAR CANE, 1915-16.

No. of square and killa.	AREA.		Variety.	Treatment.	WEIGHT OF TOPS.		WEIGHT OF CANES.		WEIGHT OF JUICE.		WEIGHT OF GUB.		OUTTURN OF GUB PER ACRE.		Percentage of green tops to cane.	Percentage of juice to cane.	Percentage of gur to juice.	Percentage of gur to cane.	REMARKS.
	Kanals.	Masals.			Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.					
1	2	3	Katha	...	56	35	67	17	35	20	6	15	23	26	84.3	52.6	18.0	9.5	Ploughing ... 6
																			Harrowing ... 5
																			Sobagaing ... 16 + 1 roller.
																			Hoeing ... 4
																			Watering ... 13
2	1	13	Kansar	...	36	36	63	36	35	7	6	12	30	21	57.7	55.0	17.8	9.8	Date of sowing, 12th April 1915 and 14th April 1915.
																			Crushing began on 14th December 1915 and finished on 27th December 1915.
3	2	0	Katha	...	47	10	78	13	42	35	8	0	32	0	60.3	54.7	18.6	10.2	
4	2	3	Kansar	...	44	38	57	5	31	12	5	39	22	11	76.8	54.7	19.08	10.4	

Statement No. 16 (a)

SHOWING THE RESULT OF HYDRAULIC EXPERIMENT ON WHEAT GROWN IN SQUARE 10-A IN RABI 1915-16.

No. of square and plot.	No. of sub-plot.	Treatment.	AREA.		ACTUAL OUTTURN.				OUTTURN PER ACRE.				Irrigation in inches before sowing.	Irrigation in inches after sowing.	REMARKS.
					Grain.		Bhusa.		Grain.		Bhusa.				
			Kanals.	Marlas.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.			
10 A ₁ a	1	2 kiaris, ordinary cultivation, no harrowing and 4 waterings.	2	0	8	16	18	36	38	24	75	24	2-77	10-1	Ploughing 4, harrowing 7, sohagaing 6, watering 4. Date of sowing, 9th November 1915. Date of harvesting, 25th April 1916. Lodging is 85 per cent.
	2	2 kiaris, ordinary cultivation, deep harrowing and 3 waterings.	2	0	8	7	21	33	32	30	87	14	2-89	8-6	Ploughing 4, harrowing 7, lever harrowing 3, sohagaing 6, watering 3. Date of sowing, 9th November 1915. Date of harvesting, 25th April 1916. Lodging is 95 per cent.
	3	2 kiaris, ordinary cultivation, no harrowing and 4 waterings.	2	0	7	20	22	36	30	0	91	24	2-89	11-53	Ploughing 4, harrowing 7, sohagaing 6, watering 4. Date of sowing, 9th November 1915. Date of harvesting, 25th April 1916. Lodging is 93 per cent.
	4	2 kiaris, ordinary cultivation, deep harrowing and 3 heavier waterings.	2	0	8	1	26	20	32	4	106	0	2-43	9-93	Ploughing 4, harrowing 7, lever harrowing 3, sohagaing 6, waterings 3. Date of sowing, 9th November 1915. Date of harvesting, 25th April 1916. Lodging is 99 per cent.
10 A ₂ a	1	2 kiaris, ordinary cultivation, no harrowing and 4 waterings.	2	0	7	29	16	21	30	32	66	4	2-89	11-71	Ploughing 4, harrowing 7, sohagaing 6, watering 4. Date of sowing, 9th November 1915. Date of harvesting, 25th April 1916. Lodging of wheat is 82 per cent.
	2	2 kiaris, ordinary cultivation, deep harrowing and 3 waterings.	2	0	8	1	14	16	32	4	57	24	3-06	9-83	Ploughing 4, harrowing 7, wheat harrowing 3, sohagaing 6, watering 3. Date of sowing, 9th November 1915. Date of harvesting, 25th April 1916. Lodging of wheat is 90 per cent.
	3	2 kiaris, ordinary cultivation, no harrowing and 4 waterings.	2	0	8	2	17	9	32	8	68	36	3-28	12-79	Ploughing 4, harrowing 7, sohagaing 6, watering 4. Date of sowing, 9th November 1915. Date of harvesting, 25th April 1916. Lodging of wheat is 75 per cent.
	4	4 kiaris, ordinary cultivation, deep harrowing and 3 heavier waterings.	2	0	7	38	19	20	31	32	78	0	3-17	10-83	Ploughing 4, harrowing 7, wheat harrowing 3, sohagaing 6, watering 3. Date of sowing, 9th November 1915. Date of harvesting, 25th April 1916. Lodging of wheat is 98 per cent.
10 A ₁ b	1	Ordinary cultivation with 16 kiaris per acre.	2	0	7	24	12	13	30	16	49	12	2-72	13-17	Lodging is only 4 per cent.
	2	Ordinary cultivation with 8 kiaris per acre.	2	0	6	30	11	31	27	0	47	4	2-88	10-24	The plot is poor by 10 per cent. Lodging is 10 per cent.
	3	Ordinary cultivation with 4 kiaris per acre.	2	0	6	4	12	6	24	16	48	24	4-31	13-32	The plot is poor by 12 per cent. Lodging is 50 per cent.
	4	Ordinary cultivation with 8 kiaris per acre.	2	0	7	18	14	14	29	32	57	16	2-77	10-27	Lodging is 50 per cent.
10 A ₂ b	1	Ordinary cultivation with 16 kiaris per acre.	2	0	7	10	11	25	29	0	46	20	3-34	13-44	Lodging 7 per cent.
	2	Ordinary cultivation with 8 kiaris per acre.	2	0	7	4	13	14	28	16	53	16	2-94	9-78	Lodging 25 per cent.
	3	Ordinary cultivation with 4 kiaris per acre.	2	0	7	23	14	19	30	12	57	36	3-17	13-84	Lodging 85 per cent.
	4	Ordinary cultivation with 8 kiaris per acre.	2	0	7	14	13	27	29	16	54	28	3-23	10-3	Lodging 45 per cent.

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Ploughing ... 4 | Lever harrowing ... 3 | Watering ... 4 | Date of harvesting, 25th April 1916.
 Harrowing ... 7 | Sohagaing ... 6 | Date of sowing, 9th November 1915.



Statement No. 16 (b)

SHOWING THE RESULT OF HYDRAULIC EXPERIMENT ON TORIA GROWN IN SQUARE 10 IN 1915.

No. of square plot.	No. of sub-plot.	Treatment.	Area.		ACTUAL OUTTURN.				OUTTURN PER ACRE.				Irrigation in inches before sowing.	Irrigation in inches after sowing.	REMARKS.
					Grain.		Bhusa.		Grain.		Bhusa.				
			Kanals.	Marlas.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.			
10 B ₁ b	1	2 kharis, ordinary cultivation, light flow in irrigation.	2	0	2	28	5	8	10	33	20	32	3.32	8.1	Ploughing ... 1 Harrowing ... 5
	2	2 kharis, ordinary cultivation, light flow in irrigation.	2	0	2	14	4	12	9	18	17	8	3.44	7.49	Sohagaing ... 2 Watering ... 3
	3	2 kharis, ordinary cultivation, heavier flow in irrigation.	2	0	2	36	5	22	11	24	22	8	3.325	8.01	Date of sowing, 21st September 1915.
	4	2 kharis, ordinary cultivation, heavier flow in irrigation.	2	0	2	15	3	27	9	22	14	28	3.325	8.54	Date of harvesting, 19th February 1916.
10 B ₂ b	1	2 kharis, ordinary cultivation, light flow in irrigation.	2	0	2	5	4	2	8	23	16	8	7.55	3.05	Ploughing ... 1 Harrowing ... 5
	2	2 kharis, ordinary cultivation, light flow in irrigation.	2	0	2	8	4	16	8	34	17	24	7.0	3.11	Sohagaing ... 2 Watering ... 3
	3	2 kharis, ordinary cultivation, heavier flow in irrigation.	2	0	2	27	4	35	10	31	19	20	8.87	2.98	Date of sowing, 21st September 1915.
	4	2 kharis, ordinary cultivation, heavier flow in irrigation.	2	0	2	23	4	37	9	12	19	28	8.69	3.05	Date of harvesting, 18th February 1916.
10 C ₁ b	1	Ordinary cultivation with 16 kharis per acre.	2	0	2	21	5	6	10	6	20	24	2.62	8.8	Ploughing ... 1 Harrowing ... 5
	2	Ordinary cultivation with 8 kharis per acre.	2	0	2	12	4	24	9	8	18	16	2.68	7.25	Sohagaing ... 2 Watering ... 3
	3	Ordinary cultivation with 4 kharis per acre.	2	0	2	27	4	37	10	30	19	28	3.53	11.97	Date of sowing, 21st September 1915.
	4	Ordinary cultivation with 8 kharis per acre.	2	0	2	19	5	5	9	38	20	22	3.35	8.99	Date of harvesting, 17th February 1916 to 18th February 1916.
10 C ₂ b	1	Ordinary cultivation with 16 kharis per acre.	2	0	2	35	5	0	11	20	20	0	3.27	7.21	Ploughing ... 1 Harrowing ... 5
	2	Ordinary cultivation with 8 kharis per acre.	2	0	2	31	4	25	11	6	18	20	2.66	6.7	Sohagaing ... 2 Watering ... 3
	3	Ordinary cultivation with 4 kharis per acre.	2	0	2	5	4	28	8	22	18	32	4.24	9.55	Date of sowing, 21st September 1915.
	4	Ordinary cultivation with 8 kharis per acre.	2	0	2	18	5	1	9	34	20	4	2.88	7.42	Date of harvesting, 19th February 1916 and 18th February 1916.

SHOWING THE RESULT OF CALCIUM NITRATE ON WHEAT GROWN, SQUARE 7, IN RABI 1916.

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Statement No. 18

SHOWING HOT WEATHER CULTIVATION *VERSUS* RAIN PLOUGHING WITH TENANTS IN RABI 1915-16.

HOT WEATHER PLOUGHING.

No. of square.	No. of plot.	Type of wheat.	AREA.		ACTUAL OUTTURN.				OUTTURN PER ACRE.				REMARKS.
			Kharas.	Marlas.	Grain.		Bhusa.		Grain.		Bhusa.		
					Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
6	7	Pusa 12	9	2	22	10	52	10	19	22	45	37	Ploughed on 7th May 1915.
6	9	Punjab 11	8	17	14	8	22	24	12	33	20	17	Ploughed on 6th May 1915.
6	11	Pusa 12	7	2	13	0	26	23	14	26	29	37	Ploughed on 5th May 1915.
6	13	Punjab 11	8	1	17	20	35	36	17	15	35	27	Ploughed on 6th May 1915.

RAIN PLOUGHING.

No. of square.	No. of plot.	Type of wheat.	AREA.		ACTUAL OUTTURN.				OUTTURN PER ACRE.				REMARKS.
			Kanals.	Marlas.	Grain.		Bhusa.		Grain.		Bhusa.		
					Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
6	8	Punjab 11	8	12	12	25	25	37	11	29	24	4	Ploughed on 22nd September 1915.
6	10	Pusa 12	7	11	13	0	23	18	13	31	24	33	Ploughed on 21st September 1915.
6	12	Punjab 11	8	7	12	34	22	37	12	12	21	35	Ploughed on 24th September 1915.
6	14	Pusa 12	8	11	14	20	30	32	13	22	28	32	Ploughed on 23rd September 1915.

Ploughing 2
Harrowing 2
Watering 4
Lever harrowing 3

Date of sowing, 8th November 1915.

Date of harvesting, 11th April 1916 to 21st April 1916.

Date of rainfall—

11th June 1915 '04 inch.
13th June 1915 '54 "
15th June 1915 '31 "
1st July 1915 '16 "
24th July 1915 '10 "
19th August 1915 '47 "

Statement No. 19

SHOWING THE RESULT OF VARIETY AND SPACING EXPERIMENT WITH MANGEL WARZELS
DURING RABI 1915-16.

No. of square.	No. of plot.	Area in acres.	Name of variety.	Distance between the rows.	ACTUAL OUTTURN.				OUTTURN PER ACRE.				REMARKS.
					Roots.		Leaves.		Roots.		Leaves.		
					Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
27 A-2	1	$\frac{3.9}{4.0}$	Mangel, long, red	28 inches ...	206	27	19	16	1,021	30	95	36	Farm yard manure at 15 tons per acre.
	2	$\frac{4.0}{4.0}$	Yellow globe ...	28 inches ...	146	7	7	12	722	29	36	3	Ditto.
	3	$\frac{4.0}{4.0}$	Long, red ...	16 inches ...	202	8	15	14	1,004	23	75	35	Ditto.
	4	$\frac{4.0}{4.0}$	Yellow globe ...	16 inches ...	124	7	16	30	613	36	76	25	Ditto.

Ploughing ... 4
 Harrowing ... 15
 Sohagaing ... 10
 Ridge making ... 1
 Watering ... 17
 Hoeing and weeding ... 5
 Earthing ... 2
 Date of sowing, 17th October 1916.
 Date of harvesting, 23rd April to 16th May 1915.

Statement No. 20 (a)

SHOWING THE RESULT OF BONE MEAL AND GYPSUM TRIAL WITH TORIA IN TENANTS' LAND IN RABI
1915-16.

No. of square and kills.	No. of plot.	Name of crops.	AREA.		Treatment.	ACTUAL OUTTURN.				OUTTURN PER ACRE.				REMARKS.
			Kanas.	Marlas.		Grain.		Bhusa.		Grain.		Bhusa.		
						Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
13 10	1	Toria...	2	4½	Unmanured ...	3	25	6	23	12	38	23	20	Ploughing ... 2
	2	Do. ...	2	4½	Bone meal at 4 maunds per acre.	3	11	5	30	11	28	20	22	Harrowing ... 2
	3	Do. ...	2	4½	Gypsum 6 maunds per acre.	3	19	5	30	12	17	20	22	Watering ... 3
	4	Do. ...	2	4½	Unmanured ...	3	24	6	14	12	34	22	28	Date of sowing, 10th September 1915.
13 11	1	Do. ...	1	19½	Bone meal ...	2	37	6	34	11	31	27	22	Date of harvesting, 22nd January to 16th February 1916.
	2	Do. ...	1	19½	Gypsum ...	2	32	6	35	11	10	27	27	
	3	Do. ...	1	19½	Unmanured ...	2	23	6	5	10	14	24	26	
	4	Do. ...	1	19½	Bone meal ...	2	35	7	10	11	23	29	7	
13 20	1	Do. ...	2	3½	Gypsum ...	2	34	4	19	10	19	16	18	
	2	Do. ...	2	3½	Unmanured ...	2	38	4	25	10	34	17	0	

Statement No. 20 (b)

SHOWING THE RESULTS OF BONE MEAL AND GYPSUM TRIAL WITH WHEAT IN TENANTS' AREA IN RABI 1915-16.

No. of square and killa.	No. of plot.	Name of crop.	AREA.		Treatment.	ACTUAL OUTTURN.				OUTTURN PER ACRE.				REMARKS.
			Kanals.	Marlas.		Grain.		Bhusa.		Grain.		Bhusa.		
						Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
16 8	1	Wheat	1	17	Unmanured ...	4	5	9	1	18	36	39	1	Ploughing ... 2
	2	Do.	1	17	Bone meal at 4 maunds per acre.	5	7	9	8	22	15	39	31	Harrowing ... 3
	3	Do.	1	...	Gypsum at 8 maunds per acre.	5	10	8	37	22	28	38	24	Watering ... 4
	4	Do.	1	...	Unmanured ...	5	20	8	39	23	31	38	32	Hoeing and weeding ... 2
	5	Do.	1	...	Bone meal ...	5	14	9	26	23	5	41	29	Date of sowing, 10th November 1915.
16 13	1	Do.	1	...	Gypsum ...	5	18	11	26	26	17	59	19	Date of harvesting, 17th April 1916.
	2	Do.	1	...	Unmanured ...	5	14	14	1	25	37	68	0	
	3	Do.	1	...	Bone meal ...	6	0	19	22	29	3	65	28	
	4	Do.	1	...	Gypsum ...	6	14	14	16	30	31	69	32	
	5	Do.	1	...	Unmanured ...	5	37	13	10	28	29	64	9	

APPENDIX VII.

Report of the Officiating Deputy Director of Agriculture on the
Gurdaspur Farm.

Introductory.—I have been in charge of the Gurdaspur Farm for about eight months of the year under report. Mr. Faulkner, the third Deputy Director, took over charge of the farm on the 3rd of January 1916, but was relieved by me on the 27th of April, as he had to go to Lyallpur to work as Professor of Agriculture in the absence of Mr. Roberts on leave. I have been since then in charge.

Season and its effects upon the crops.—The total rainfall during the year (July 1st, 1915, to June 30th, 1916) was 16·70" (Statement No. 1), as compared with 59·92" in the preceding year. The normal rainfall here is 34·9 inches. The season accordingly was very dry; there being only two good showers of rain (one in August, 3" and one in October, 1·97") throughout the whole year.

Both kharif and rabi crops suffered greatly through this draught, and outturns were very low; but good cultivation tells in a year like this, and in spite of the fact that the season was so dry our outturns of barani wheat were three times the average outturns of the district. The grain was well filled, and the outturns were much better than were expected. The yield of bhusa was low as the vegetative growth was stunted. These rather unexpected outturns in the barani area this year led us to conclude that air is as important for the roots as water and that after tillage and the keeping the surface loose for the free access of air is quite an important factor in obtaining high yields. The winter was not very cold and frost did not do any serious damage.

Crop pests.—There were no serious crop pests during the year under report. Scale insects were bad on sugarcane and did severe damage to the new Egyptian cane. Although the season was dry and the conditions were not very favourable for it, rust was on the whole bad on wheats. Smut was also noticed on wheats and the late tillers of sugarcane, but no damage was done.

Chahi area.—For rotations on, and divisions of, the farm and details of experiments, see former reports. Last kharif (1915) experiments with chemical manures for sugarcane to ascertain how far the yield can be increased were also started. They must continue a good number of years before any definite results are obtained. For details and results see below, and also statement No. 3.

Kharif—Sugarcane.—*Statements Nos. 2 and 3.*—The crop started very well with the exception of a few varieties whose seed was somewhat spoilt through long burial and great seasonal changes during the time it remained under ground; February and March 1915 were wet. During the hot months of June and July the crop suffered a little for want of good irrigation and from an attack of white ants. Scale insects too were bad. The later waterings made the crop late, and all the above combined to make the yield low. Smut was noticed only on the late tillers.

Of the 19 varieties of thin cane, which were kept on for their good results and promising behaviour last year (1914-15), only 14 have been retained after this year's tests for further trial, and the rest have been discarded. Five of these—Sonabli, Dhaura of Azamgarh, Reora of Benares, Suretha, Mango—have almost always given good results, and have this year (1916) been given out in the district for a trial on zamindars' fields. Bihar (locally known as kahū) gives very high outturns, but it needs plenty of irrigation and is very susceptible to pests, drought, frost, etc.

Some seven varieties of thick canes are also grown on a small area. We are keeping them on for seed only. Egyptian cane appears to be doing better than it did at Lyallpur. Seed of J. 33 was also obtained from the United Provinces. Both have been grown on $\frac{1}{4}$ acre, and the results will be awaited with interest. They are well spoken of and give very good yields elsewhere. They are not very thick and, if found successful, will easily replace the thin varieties for gur making.

Besides these varietal tests manurial experiments with artificial fertilizers were also started. Statement No. 3 gives details. All the plots were duplicated. The manures were given in two doses, half was applied with the first irrigation and the remaining half with the second. The results, I am sorry to say, are not much to be relied on. As the new channels were being laid on the farm the fields did not get quite uniform irrigation. The channels lying to the south and east of this field had just been raised, and not being well set, badly leaked, with the result that a good portion of the field to the south and east received much heavier waterings than the rest. Still the perusal of the statement will be found interesting and will give some idea of the action of the manures. Superphosphate and lime have given very good results, and next in order of importance come superphosphate and potash, while the complete manure (all the four together) had given very poor results. Superphosphate appears to be beneficial, and manures not containing phosphates appear to be quite useless.

Single lines of Dholu streaked and streakless were continued, and it was again noticed that streakless type does not remain true. It is not a permanent character.

Maize.—*Statement No. 4.*—Very little experimental work has been done with maize so far, and varietal tests will be started this year (1916). Cultivation, manurial, early and late sowing and spacing experiments will also be taken up next year as space permits.

The varietal experiment with this crop was a test between the local and the Jullundur grain. The results are in favour of the former. In field No. 4 the residual effects of the manures applied to the previous wheat crop were also noticed on this crop. Wheat had been manured with green and phosphatic manures separately and together. Superphosphate and green manure together gave better results than either of them separately.

Cotton.—As explained last year cottons are grown for the Economic Botanist, Punjab, to see the effect of climate and environments on the quality of the lint.

Three varieties were grown :—

(1) Indicum, (2) Sanguineum, and (3) American 199 F.

The results are :—

				Outturns per acre.	
				Mds.	Srs.
(1)	Indicum	...	...	6	33
(2)	Sanguineum	...	...	6	26
(3)	American 199 F.	...	...	4	26

Senji (*Melilotus parviflora*) is taken as a catch crop between the maize and sugarcane crops when the latter follows the former, and also in fields under cotton. The crop pays well, as green fodder is generally scarce during the months of January and February. It paid very well (up to Rs. 11 per kanal or Rs. 110 per acre) this year, as fodder was exceptionally scarce.

Wheat.—*Statement No. 7—Rabi.*—There were 8 acres under chahi wheats. Manurial and varietal trials were conducted on this area. Superphosphate was the only manure which was tested. The results are given in Statements Nos. 5 and 7 along with the results obtained on the barani area, and as the same or similar experiments were carried out on that area also the results are discussed together under that area.

Barani area.—Wheat is the main crop under investigation on this area. Experiments are being carried on to find the (1) best type of wheat that will yield well on barani soils, (2) the manure or manures most suitable for barani wheat lands to get the maximum outturn of grain, and (3) the method of cultivation that will best increase the fertility and the moisture capacity of barani soils. The rotation practised is the general barani rotation of wheat-kharif-fallow-fallow-wheat and so on.

Mash (*Phaseolus Mungo*) therefore follows wheat on this area in kharif to complete the rotation. It is a common legume in this district, and pays well. Its bhusa too is good for cattle during winter. Broadcasting *versus* drilling was the one experiment tried with this (*mash*) crop besides ascertaining the residual effect of the manures and cultivation given to the previous crop of wheat. Monsoon failed, and the season was very dry; no results therefore could be obtained. The outturns were poor, the highest yield being 2 maunds 12 seers per acre. The results in the case of drilled *versus* broadcasted were :—

Broadcasted	...	...	1 maund and 34 seers per acre.
Drilled	...	...	1 maund and 15 seers per acre.

Rabi.—*Wheat.*—It has been mentioned above that the year was very dry and so very bad for barani crops; and as such particularly suited to test our methods of conservation of moisture. There is no doubt that better cultivation scores in a season like this, and our results were very satisfactory and convincing. Even in a dry year like this the rust on the leaves was present and was very bad on Pusa 110, and Mr. Milne's new wheat 17 B and 20 C. It was also present in the ears of Pusa 12. Smut was present on Pusa and was rather bad on Punjab 11, 13, 14 and 8 B. White ants did some damage to the barani wheats. The attack was worse in field No. 15 and 12 B (*Statement No. 6*) in the part where country plough was used than in the portion ploughed by Raja or Sabul plough.

The following work was done on wheat :—

I.—Manurial experiments, *Statement No. 5* :—

(a) Bone-meal at 5 cwt. per acre *versus* no manure (in barani area only).

(b) Superphosphate at 1½ cwt. per acre *versus* no manure (both in chahi and barani areas).

II.—Cultivation experiments, Statement No. 6 :—

- (a) Raja plough *versus* country plough.
- (b) Sabul plough (ploughing 8" deep) *versus* country plough.
- (c) Hot weather cultivation *versus* ordinary cultivation.
- (d) Permanent wheat plot.
- (e) Permanent wheat and gram plot.

III.—Comparative varietal tests between (Statement No. 7) :—

- (a) Pusa 110, 4, and 12 and Punjab 14 (on the barani area).
- (b) Punjab 11, 13 and 14 (on the chahi area).
- (c) Pusa 12 and Punjab 17 (on the chahi area).
- (d) 8 A., 8 B., 17 B. and 20 C. (on the chahi area).

I.—Superphosphate alone made the crop earlier on the chahi area by about three days. There was no improvement of the quality of grain by the use of these manures. Manured plots gave a little higher yields than unmanured, but the increase does not encourage us in the use of these fertilizers. However more elaborate and extensive trials with these phosphatic manures combined with bulky organic manures have been started now to find out if they will ever pay.

II.—Comparatively deep ploughing has given better results than shallow ploughing, (Statement No. 6, Raja plough *versus* country plough or Sabul plough *versus* country plough). It will be interesting to know in this connection that the plots ploughed by country plough had always been ploughed by Raja plough previously since 1910, and it was only last year that the plot was cultivated with the country plough. Moreover, two ploughings with the country plough were given against one with the Raja.

Raja plough goes 5"-6" deep and the Sabul plough 8". The results in the case of Sabul *versus* country plough are not very encouraging to the Sabul, compared with the results given by the Raja plough in the test of Raja *versus* country, considering the expense and labour involved by the Sabul plough. This deep ploughing may, however, help next year, but as this is the first year of the experiment, nothing definite can be said on the point. The results of further trials should be awaited.

Hot weather cultivation has no advantage over ordinary cultivation. In fact our ordinary cultivation in principle is really what is meant by hot weather cultivation, and the extra trouble that we take on this so-called hot weather cultivation seems apparently fruitless. This trial will continue for another year, and if the results do not improve this experiment will be stopped. The increase in outturn is small compared with the expense of the operation.

Permanent wheat plots.—This experiment has been going on for the last three years, but the characters of the seasons had been so different that no definite conclusions can be drawn. The results obtained so far are in favour of growing wheat after wheat and do not show the practice to be at all exhausting. This is only the first year of wheat and gram mixed on the permanent wheat and gram plot.

III.—These tests were carried out in the barani as well as in the chahi area. On the barani area, the Pusa wheats 110, 4, 12 and Punjab type 14 were tested against one another with Punjab 14 as standard. The results are in favour of local type 14. Pusa 110 was very badly rusted on the leaves and in the heads, and will be discontinued.

Punjab 11 seems very well suited for irrigated lands and, taken all round, it is almost unsurpassable as an irrigated wheat. This is a bearded white wheat. Pusa 12 and Punjab 17 are both beardless white wheats, and there is little to choose among them for chahi lands: if anything the results are in favour of the local type.

Four new varieties, 8 A, 8 B, 17 B, and 20 C were obtained from Economic Botanist, Punjab, for trial on this farm. They came too late to be tested against our chief local or the favoured Pusa types, and were tested against each other. 17 B and 20 C were rather badly rusted, but they yielded well—all of them. They were grown after sugarcane and thus had ideal conditions in respect of cultivation and land. Next rabi they will be tested against local and Pusa wheats.

Pusa wheats—Different Pusa wheats have been grown on this farm since 1911. Only two, known as Pusa 4 and Pusa 12, the most promising, have been kept on. Pusa 12 is now generally grown in the Central districts. This year there were some 2,400 acres under it in the districts of Jullundur, Hoshiarpur and Gurdaspur and over 8,000 maunds of seed has been stored for future distribution. The behaviour of these wheats each year has been discussed in former reports. This was a very good year to test them against the local types, and, as the results show, they have not compared favourably with the latter, which do better under adverse conditions. These wheats do well in a good year, but they need comparatively better lands and better cultivation. I am very doubtful as to their suitability to poor lands and conditions.

Pusa 4 needs even better conditions than Pusa 12. We are going to try it further, especially on good land and under irrigation, in the hopes that it will do well under these conditions. It has an advantage over Pusa 12 of being absolutely rustless, while the latter is rusted even in the ears, and one cannot feel confident that a failure could not occur in such a wheat. Both these wheats are beardless and ripen all at once and, however successful they might be, the area under them will always be, for this last reason, limited.

Some 14 new crosses on Pusa 6 and Pusa 4 were sent by Imperial Economic Botanist, Pusa, to be grown on very small area, to give him an idea of a suitable type for these parts. They were grown on rather poor land, and in spite of the dry season did well. Mrs. and Mr. Howard visited them in February last and discarded three of them for their easy susceptibility for rust. The remainder will be grown on as large areas as the seed will allow for further trial.

Fertilizers.—See last year's report for the purposes of this experiment. Sodium nitrate was again tried this year in two different villages at different rates. The results are given in Statement No. 8: the experiments do not justify their cost.

Implements.—The Raja plough and spring tined harrow continue to be our chief implements of cultivation. The peg toothed harrows have been found very beneficial for harrowing young crops. A Hosier 7 disc drill has been obtained this year, but it came too late for any trial and will be tried next year.

The farm consists of 89 acres under actual cultivation; half of this is chahi and is earmarked for sugarcane experiments. The other half is barani and is devoted to trials of different wheats and dry farming experiments. But the area is too small for tests of wheat on any large scale, and no thorough test of either the Punjab or Pusa or Mr. Milne's types have so far been made on a sufficiently large scale. Proposals are being sent up to extend the farm by the addition of another 50 acres of land adjoining. This new area would all be reserved for trials with the different wheats, and we hope in the course of a few years to be able to say definitely which shall be our future wheats for the different tracts.

Visitors.—The local zamindars of the neighbourhood frequent the farm to enquire into different things, to buy seeds and implements, to report pests and to find out remedies to combat them. Parties of zamindars and officials from Rohtak, Multan, Ludhiana, Hoshiarpur, Jullundur, Amritsar and Ferozepore Districts visited the farm during March and April 1916. The visitors during these months alone numbered some 200. It is very desirable that some arrangements to accommodate this ever-increasing number of visitors at the farm be made.

M. FATEH-UD-DIN,

Offg. Deputy Director of Agriculture, Punjab.

Statement No. 1.

RAINFALL DURING THE YEAR 1914-15 AND 1915-16.

Name of month.	1914-15.	1915-16.
June	4.44	.62
July	31.92	3.9
August	2.05	4.79
September	5.03	2.83
October	3.43	1.97
November	.59	..
December	1.85	.07
January	2.21	.1
February	4.63	1.31
March	2.30	.23
April	.47	.86
May	...	.52
Total ...	59.92	16.70

Statement No. 2.

SUGARCANE VARIETIES.

No. of field.	Name of variety	Area harvested in square yards.	WEIGHT OF CANES.		WEIGHT OF JUICE.		WEIGHT OF GUR.		WEIGHT OF CANE PER ACRE.		WEIGHT OF JUICE PER ACRE.		WEIGHT OF GUR PER ACRE.		Percentage of juice to canes.	Percentage of gur to juice.	Percentage of gur to canes.	REMARKS.
			Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.				
1	Sonabelli	771	69	28	48	0	5	30	437	16	269	36	36	4	61.70	13.38	8.25	
	Behar	840	95	30	62	2	8	21	551	24	357	20	49	4	64.8	13.74	8.90	
	Saretha	840	59	1	40	20	4	39	340	4	233	12	86	26	68.61	12.28	8.43	
	Lalri	2,148	135	22	86	24	12	79	305	24	195	4	28	4	68.86	14.41	9.20	
	Dhaura of Azamgarh	974	84	36	46	25	6	0	421	32	231	28	29	38	54.93	12.86	7.07	
	Reaura of Benares	888	60	1	39	5	4	29	327	8	213	8	25	30	65.18	12.08	7.84	
	Mango	810	58	13	31	5	4	16	348	20	186	0	26	12	53.37	14.14	7.54	
	Badi	2,280	146	13	86	10	10	7	310	24	183	4	21	24	58.95	11.80	6.95	
	Pataski mango	2,280	208	18	119	25	13	29	442	28	253	36	29	6	57.36	11.48	6.59	
	Katha	610	45	7	25	30	4	7	358	20	204	12	33	5	56.99	16.21	9.24	
7	Do.	898	77	11	48	20	5	19	416	16	261	12	29	20	62.76	11.29	7.09	
	Katara	1,060	65	18	45	26	5	37	298	32	208	11	27	2	69.76	12.98	9.05	
	Kanera	1,950	144	13	86	10	9	34	359	12	214	4	24	18	59.58	11.42	6.803	
	Tareru	212	17	29	10	5	1	7	404	32	231	8	26	33	57.12	11.61	6.628	
	Chin	206	18	17	10	30	1	18	432	36	252	20	34	2	58.34	13.49	7.87	
	Kansar	112	8	5	3	29	0	18	351	8	161	0	19	18	45.83	12.08	5.538	
	Nargori	72	4	6	2	22	0	14	278	36	171	16	28	21	61.45	13.73	8.435	
	Khami	105	6	0	4	32	0	20	276	24	221	8	23	2	79.98	10.42	8.33	

Statement No. 3.

EFFECT OF CHEMICAL MANURES ON SUGARCANE (LOCAL DEHLU).

No. of field and plot.	Area harvested, in square yards.	Treatment.	WEIGHT OF CANES.		WEIGHT OF JUICE.		WEIGHT OF GUM.		WEIGHT OF CANES PER ACRE.		WEIGHT OF JUICE PER ACRE.		WEIGHT OF GUR PER ACRE.		Percentage of juice to canes.	Percentage of gur to juice.	Percentage of gur to canes.
			Mds.	Srs.	Mds.	Srs.	Mds.	Srs.	Mds.	Srs.	Mds.	Srs.	Mds.	Srs.			
2-1	866	Untreated	71	15	44	24	5	17	898	86	249	8	30	13	82.47	12.16	7.6
2-2	1,006	Lime	81	28	58	29	6	31	393	4	232	24	32	24	71.88	11.53	8.23
2-2		Am. sulphate															
2-3	1,047	Unmanured	91	26	55	23	8	8	423	28	256	36	37	36	60.64	14.75	8.94
2-4	897	Potash Sulphate	86	17	53	20	6	15	466	12	288	28	34	16	61.90	11.91	7.37
2-4		Super															
2-5	1,047	Lime	86	23	48	5	6	9	400	12	222	20	28	31	55.59	12.93	7.19
2-5		Am. Sulphate															
2-5		Super															
2-5		Pot. Sulphate															
2-6	1,047	Pot. Sulphate	84	9	52	20	7	26	389	20	242	32	35	15	62.33	14.57	9.03
2-6		Am. Sulphate															
2-7	1,047	Unmanured	88	36	56	...	7	38	411	4	258	36	36	30	62.99	14.20	8.94

[illegible]

Statement No. 4.

EFFECT OF MANURES ON MAIZE.

No. of field.	Variety.	Area in square yards.	Previous treatment on wheat.	ACTUAL YIELD OF GRAIN.		YIELD OF GRAIN PER ACRE.		REMARKS.
				Maunds.	Seers.	Maunds.	Seers.	
4	Local ...	1,574	Green manure + Superphosphate 1½ cwt. per acre.	6	23	20	8	
	Do. ...	1,574	Superphosphate 1½ cwt. per acre ...	5	12	16	11	
	Do. ...	1,574	Green manure ...	4	31	14	28	
	Do. ...	1,574	No manure ...	4	0	12	12	
	Do. ...	1,574	Green manure ...	5	4	15	27	
	Do. ...	3,148	No manure ...	11	37	18	14	
3	Jullunduri	1,062	Superphosphate 1½ cwt. per acre + green manure.	2	29	12	17	
	Do.	1,574	Superphosphate 1½ cwt. per acre...	3	20	10	30	
	Do.	1,574	Green manure ...	3	39	12	8	
	Do.	1,232	No manure ...	3	0	11	32	
	Do.	1,232	Green manure ...	3	20	13	30	
	Do.	1,964	No manure ...	4	36	12	3	
	Local ...	5,939	Green manure ...	21	4	17	8	
	Do. ...	4,445	No manure ...	15	4	16	18	

EFFECT OF CHEMICAL MANURES ON WHEAT YIELDS.

N, B.—Price is calculated at Rs. 3-2-0 in case of white and Rs. 3 in case of red wheat.

N, B.—Price is calculated at Rs. 3-2-0 in case of white and Rs. 3 in case of red wheat.

Statement No. 6.

EFFECT OF CULTIVATION ON WHEAT.

No. of field.	Area in square yards.	Name of variety.	Cultivation.	ACTUAL OUTTURN.				OUTTURN PER ACRE.				REMARKS.				
				Grain.		Straw.		Grain.		Straw.						
				Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.					
15	5,884	Punjab 13	...	...	...	...	...	...	...	...	...	...	Ploughings	...	...	2
15	5,884	Pusa 12	...	...	...	...	...	...	...	...	...	...	S. T. H.	...	...	13
15	5,906	Punjab 13	...	...	...	...	...	...	...	...	...	...	C. plough	...	...	1
15	5,906	Pusa 12	...	...	...	...	...	...	...	...	...	...	Sohaga	...	...	6
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Wheat harrowings	...	...	2
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Date of sowing, 21st October 1915,	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Date of harvesting, 31st March 1916, and 4th-10th April 1916.	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	R. plough	...	...	2
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	S. T. H.	...	...	14
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	C. plough	...	...	1
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Sohaga	...	...	8
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Wheat harrowings	...	...	2
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Date of sowing, 30th and 31st October 1915.	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Date of harvesting, 4th, 5th, 10th & 11th April 1916.	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Ploughings	...	...	3
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	The rest similar to above.	...	...	3
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Ploughings	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	S. T. H.	...	...	3
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	C. plough	...	...	8
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Sohaga	...	...	1
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Wheat harrowings	...	...	5
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Date of sowing, 22nd October 1915.	...	...	2
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Date of harvesting, 31st March 1916.	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	R. plough	...	...	1
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	S. T. H.	...	...	8
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	C. plough	...	...	1
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Sohaga	...	...	1
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Wheat harrowing	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Date of sowing, 22nd October 1915.	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Date of harvesting, 31st March 1916.	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	R. plough	...	...	1
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	S. T. H.	...	...	6
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	C. plough	...	...	1
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Sohaga	...	...	1
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Wheat harrowing	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Date of sowing, 20th October 1915.	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Date of harvesting, 4th April 1916.	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Ploughings	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Sohaga	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Date of sowing, 20th October 1915.	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Date of harvesting, 4th April 1916.	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Ploughings	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Sohaga	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Date of sowing, 20th October 1915.	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Date of harvesting, 4th April 1916.	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Ploughings	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Sohaga	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Date of sowing, 20th October 1915.	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Date of harvesting, 4th April 1916.	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Ploughings	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Sohaga	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Date of sowing, 20th October 1915.	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Date of harvesting, 4th April 1916.	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Ploughings	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Sohaga	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Date of sowing, 20th October 1915.	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Date of harvesting, 4th April 1916.	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Ploughings	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Sohaga	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Date of sowing, 20th October 1915.	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Date of harvesting, 4th April 1916.	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Ploughings	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Sohaga	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Date of sowing, 20th October 1915.	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Date of harvesting, 4th April 1916.	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Ploughings	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Sohaga	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Date of sowing, 20th October 1915.	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Date of harvesting, 4th April 1916.	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Ploughings	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Sohaga	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Date of sowing, 20th October 1915.	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Date of harvesting, 4th April 1916.	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Ploughings	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Sohaga	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Date of sowing, 20th October 1915.	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Date of harvesting, 4th April 1916.	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Ploughings	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Sohaga	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Date of sowing, 20th October 1915.	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Date of harvesting, 4th April 1916.	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Ploughings	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Sohaga	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Date of sowing, 20th October 1915.	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Date of harvesting, 4th April 1916.	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Ploughings	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Sohaga	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Date of sowing, 20th October 1915.	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Date of harvesting, 4th April 1916.	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Ploughings	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Sohaga	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Date of sowing, 20th October 1915.	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Date of harvesting, 4th April 1916.	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Ploughings	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Sohaga	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Date of sowing, 20th October 1915.	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Date of harvesting, 4th April 1916.	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Ploughings	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Sohaga	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Date of sowing, 20th October 1915.	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Date of harvesting, 4th April 1916.	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Ploughings	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Sohaga	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Date of sowing, 20th October 1915.	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Date of harvesting, 4th April 1916.	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Ploughings	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Sohaga	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Date of sowing, 20th October 1915.	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Date of harvesting, 4th April 1916.	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Ploughings	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Sohaga	...	...	...
17	2,418	Pusa 4	...	...	...	...	...	...	...	...	...	...	Date of sowing, 20th October 1915.	...	...	...
17	2,418	Punjab 14	...	...	...	...	...	...	...	...	...	...	Date of harvesting, 4th April 1916.	...	...	...
17	2,4															

N.B.—Ploughing = R. plough or Sabul plough or 2 country ploughs.

Statement No. 7.

COMPARATIVE TEST OF WHEATS.

Field.	Type No.	Actual area reaped, in square yards.	ACTUAL OUTTURN.				OUTTURN PER ACRE.				REMARKS.
			Grain.		Straw.		Grain.		Straw.		
			Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
13	Pusa 110 " 12 " 4 Punjab 14	3,848 4,061 4,329 4,635	2 8 5 10	21 13 30 11	9 17 13 22	23 8 9 10	3 9 6 10	7 37 17 29	12 20 14 23	2 20 32 10	R. plough = 2; C. plough = 1; S. T. H. = 14; Sohaga = 7; Wheat harrowings = 1
10 A	8 A 8 B 20 C 17 B Punjab 17 Pusa 12	1,999 2,901 1,999 1,913 1,747 1,734	10 8 8 7 7 7	7 30 33 13 23 18	25 22 21 18 18 15	28 8 19 36 32 18	24 21 21 18 21 20	25 6 14 31 0 32	62 53 52 47 52 43	9 20 0 33 4 5	R. plough = 2; C. plough = 1; S. T. H. = 6; Sohaga = 7; Disc harrow = 2; Wheat harrow- ing = 1; Date of sowing, 24th October 1915; Date of harrowings, 15th and 16th April 1916.
10 B	Punjab 11 " 13 " 14 8 A 8 B 17 B 20 C	3,823 3,935 3,935 1,069 1,069 1,069 1,069	17 15 15 5 5 4 5	24 33 7 33 31 24 11	30 41 37 19 17 21 15	20 23 39 22 26 37 36	22 19 18 26 26 20 23	11 25 26 14 6 33 35	38 51 46 88 79 99 71	24 5 28 19 35 10 38	R. plough = 2; C. plough = 3; S. T. H. = 5; Sohaga = 6; Wheat harrowing = 1; Date of sow- ing, 20th November 1915; Date of harvesting, 17th, 22nd and 23rd April 1916. R. plough = 2; C. plough = 3; S. T. H. = 5; Sohaga = 6; Wheat harrowing = 1; Date of sow- ing, 2nd November 1915; Date of harvesting, 13th and 14th April 1916. R. plough = 2; C. plough = 3; S. T. H. = 5; Sohaga = 6; Wheat harrowing = 1; Date of sow- ing, 2nd November 1915; Date of harvesting, 13th and 14th April 1916.

Statement No. 8.

RESULTS OF SODIUM NITRATE EXPERIMENT ON WHEAT IN GURDASPUR DISTRICT, VILLAGES BHANGWAN AND MUSTAFABAD

Serial No.	Area in square yards.	Quantity of manure applied.	GRAIN OUTTURN.		BRUSA OUTTURN.		TOTAL GRAIN OUTTURN PER ACRE.		Value of yield per acre— Grain Rs. 3-2 Brusa Rs. 0-12.	Cost of manure per acre.	Profit or loss.	Name of village.	REMARKS.
			Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.					
1	1,210	28 lbs.	1	17	2	29	16	24	Rs. A. P.	11 0 0	Loss	Mustafabad	...
2	1,219	42 "	1	30	3	35½	22	22	33 10 0	16 8 0	Do.	Do.	...
3	540	66 "	0	28	1	20½	17	28	26 8 0	44 0 0	Do.	Do.	...
4	1,210	No manure	1	12	2	12	14	36	23 12 0	...	...	Do.	...
5	605	Do.	0	22½	1	44	13	16	20 10 0	...	...	Bhangwan	...
6	605	14 lbs.	0	15	0	26	8	8	11 8 0	5 8 0	Loss	Do.	...
7	605	21 "	0	14	0	28	8	16	12 10 0	16 8 0	Do.	Do.	...
8	605	28 "	0	12	0	19	6	8	11 0 0	22 0 0	Do.	Do.	...
9	605	7 "	0	22	0	23	9	0	17 4 0	5 8 0	Do.	Do.	...
10	605	10½ "	0	20	0	25	9	0	16 4 0	8 4 0	Do.	Do.	...
11	470	No manure	0	12½	0	21½	8	28	14 1 6	...	...	Do.	...
12	470	14 lbs.	0	16½	0	14½	6	16	10 4 0	13 12 0	Loss	Do.	...
13	470	21 "	0	10½	0	13½	6	6	10 4 0	21 2 6	Do.	Do.	...
14	470	28 "	0	12	0	18	7	27	12 10 6	28 3 0	Do.	Do.	...
15	470	7 "	0	14	0	26	10	4	11 0 0	6 14 0	Do.	Do.	...
16	470	10½ "	0	12	0	20	8	8	14 1 6	10 4 0	Do.	Do.	...

Land irrigated once by well water; soil clay loam.

Soil sandy loam. Barani. Wheat was sown after one year's fallow. Rain fall the same as at G. A. S.

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APPENDIX VIII.

Report of the Deputy Director of Agriculture on the Hansi Farm.

(1) *Introductory.*—The farm was started in April 1914, and the permanent cropping scheme was drawn up by me in October of that year when I took over charge at Hansi, when the rabi crops of 1914-15 had already been sown. Thus the year under report is the first year of our regular experimental work.

(2) *Season and its effects.*—The total rainfall during the year (*vide* Statement No. 1.) was 4·59 inches compared with 20·93 inches in the preceding year. Practically the whole of the year was quite dry, except for some showers in the summer months which were generally too slight to do any real good to the crops. These therefore suffered from drought as the canal supply was very low. The strong winds with light showers of September did great damage to the cottons, by shaking off flowers and young bolls; the damage was worst in the plots of varietal tests. Locusts also visited the farm in August and did some damage. On the whole, however, the general condition of both kharif and rabi at the farm was good. The hot winds caused the rabi crops to ripen earlier than usual, and thus did considerable damage round Hansi by shrivelling the late ripening ears, but we were not troubled by this, as we irrigated our fields late to save them from the same fate.

Constant trouble has been felt during the latter half of the year for want of regular supply of water, and our next year's experiments are likely to suffer from the consequences thereof.

(3) *Laying and levelling of the farm area.*—The laying out of the tenants' area which was left over from last year has been finished. The whole farm has been surveyed and the water channels have been made according to the contours and they are working satisfactorily.

The kallar patches which show themselves here and there through the farm cause great difficulty in making really accurate tests and comparisons. The land having been brought under careful cultivation will no doubt improve slowly—of this it is already showing signs owing to deep and regular cultivation and irrigation—but it will be many years before the soil becomes all uniform in quality.

(4) *Barani cropping scheme.*—It is intended to make a start with barani cultivation and in addition to the cropping scheme and rotations of blocks A, B, and C as already given in my last year's report, a barani scheme for 10 acres in block E has been drawn up. The following rotations have been started :—

1. Kharif standard.—Cotton—fallow—any kharif leguminous crop—fallow.
2. Rabi standard.—Wheat—fallow—gram—fallow.
3. Rabi and kharif mixed.—Wheat—cotton—fallow.
4. Rabi and Kharif mixed.—Wheat—bajra—fallow—fallow.
5. Rabi and Kharif mixed.—Sarson—jowar.

(5) *Cotton.*—There were altogether 35 acres under experimental cottons, besides the one acre plot for breeding parasites. The experiments carried out are as follows :—

Series No. 1, varietal tests, statements Nos 2 and 3.—American 4 F, Rosea 87, Mollisoni 24, Sanguineum 20-A, local Bhatla (mixture) were grown side by side with Indicum 135-A as standard on a plot of about quarter of an acre each in area, in four duplicates. These were interstripped with jowar to prevent crossing. These cottons were late in ripening owing to the heavy vegetative growth which was due to the virgin soil: this greatly affected the fruiting. Further the strong winds in September damaged the flowers and young bolls. The American specially suffered from frost owing to late ripening: its results are, therefore, very low.

In this experiment Mollisoni has done best (in yield of kapas per acre) though Rosea comes very nearly up to it, these giving an average yield of maunds 6-20-14 and 6-16-7 per acre, respectively. Indicum 135-A comes next: followed by local Bhatla mixture: but it has a higher percentage of lint, and therefore produces more rui to the acre than Indicum 135-A, and is therefore more paying than it. Sanguineum has given very poor results of maunds 4-9-11 an acre and has been discarded. The people of this tract are well aware that white flowered plants give better yield of kapas, and kan of lint than yellow flowered, and are likely to take to Rosea or Mollisoni.

Series No. 2, spacing experiments.—These were tried with—

- (1) American cotton (4 F).
- (2) *Desi* cotton (Sanguineum 20-A).

(1) In the case of 4-F, the spacings tried were $2\frac{1}{2}$ ', 3', $3\frac{1}{2}$ ' and 4' apart. The experiment was tried in duplicate. For detailed results see statement No. 4. Average yield per acre was :—

Feet.					Mds.	Srs.	Ch.
$2\frac{1}{2}$	...	...	...	...	9	4	0
3	...	...	...	...	10	16	4
$3\frac{1}{2}$	...	...	...	...	11	27	4 (best.)
4	...	...	...	...	10	16	0

(2) Spacings with Sanguineum 20-A.

The experiment in this case was also in duplicate. Spacings were $2\frac{1}{2}$, 2 and $1\frac{1}{2}$ feet, respectively. This cotton has not done well in any case and there is no likelihood of its doing well in the tract. Hence it has been discarded and the experiment will be tried next year with white flowered Indicum isolated from local Bhatla instead.

Series No. 3-A, broad-casting versus sowing in lines.—One acre of local Bhatla had been broad-casted side by side with another acre of Bhatla grown in lines. They both received 3 hoeings with country kasola. The results are as follows :—

					Mds.	Srs.	Ch.
Broadcast	...	...	...	...	11	32	14
In lines	...	...	...	...	9	3	6

(I may add the results at Aligarh also show that broad-casting in country cottons is giving better results. However we have not yet continued with this experiment long enough to lay down any law on the subject.)

Series No. 3-B, different number of hoeings in broad-casted Bhatla cottons.—Three acres of Bhatla cotton have been grown side by side. They received 1, 2 and 3 hoeings with country kasola respectively (all other conditions being the same). The following results were obtained :—

					Mds.	Srs.	Ch.
1 Hoeing	...	...	...	...	9	23	12
2 Hoeings	...	...	...	...	12	9	11
3 Hoeings	...	...	...	...	11	32	14.

Series No. 3-C, same number of hoeings to cottons in lines but with different kinds of hoes.—Four acres of cotton were grown; the distance between rows being $2\frac{1}{2}$ feet. They all received 3 hoeings with (1) Gujrat hoe, (2) horse hoe, (3) country plough; and (4) country kasola.

The object is to find out which gives most profit with least expenditure. The following results were obtained :—

Implement.		Cost of hoeing.				Yield per acre.
		Rs.	A.	P.		Mds. Srs. Ch.
Kasola	...	6	12	0	...	9 3 6
Country plough	...	3	0	0	...	10 25 4
Horse hoe	...	1	0	0	...	9 8 10
Gujrat hoe	...	1	0	0	...	7 27 6

The Gujrat hoe is not suitable for this soil as it does not satisfactorily remove weeds : it can be worked with advantage on light soils. The country plough hoeing takes a longer time (i.e., a day an acre) than the horse hoe, which can do 3 acres a day, but the extra cost is compensated by the increased yield : the country plough hoeing was much better than any other hoeing as regards loosening of the soil.

Series No. 4, deep and shallow ploughing for cotton after fallow.—The experiment was made on three plots of an acre each, one was ploughed 9 inches deep with Sabul plough; the second $4\frac{1}{2}$ inches with the Rajah plough, and third at the ordinary depth with the country plough.

This is the first year of this experiment, and naturally we cannot get the full benefit of deep ploughing during the very first season. The results are as follows :—

					Mds.	Srs.	Chs.
Country plough	...	...	...	...	9	16	12
Rajah plough	...	...	...	...	8	8	12
Sabul plough	...	...	...	...	8	7	0

Series No. 5, selection from Bhatla Statement No 5.—Last year four types were isolated from Bhatla, which, is a mixture of all four types (i.e., Indicum yellow and white flowered,

and neglectum yellow and white flowered). These were grown on $\frac{1}{2}$ -acre plots in two duplicates. The following results are interesting :—

<i>Variety.</i>	<i>Yield per acre.</i>			<i>Percentage of lint.</i>	<i>Lint per acre.</i>		
	Mds.	Srs.	Chs.		Mds.	Srs.	Chs.
Indicum yellow flowered	...	7	28 8	31.5	2	17	3
Neglectum yellow flowered	...	8	29 10	31.7	2	30	13½
Indicum white flowered		8	11 12	36.38	3	2	12½
Neglectum white flowered	...	9	4 15	34.83	3	7	1¾

The last has done best. Neglectum yellow flowered has given 17 seers 13 chhataks (kapas) per acre more than Indicum, white flowered, but the latter beats neglectum yellow flowered, in ginning percentage, and in terms of rui Indicum white flowered is 3 maunds 2 seers, 12 $\frac{1}{2}$ chhataks against maunds 2-80-13 $\frac{1}{2}$ of neglectum yellow flowered.

Further plant to plant selections with regard to yield and percentage of lint will be made.

Miscellaneous.—(Statement No. 6.)—The environment experiments with cottons for the Economic Botanist were conducted along with the varietal tests.

2. An experiment to see the effect of growing cotton after cotton every year on the same plot of land has been started to ascertain how far such practice interferes with the balance of fertility of the soil. This is the first year of this experiment, so no results can be given.

3. *Parasite breeding plot.*—A permanent parasite breeding plot has been reserved for the entomological section on the Hansi Farm. A new plot alongside of the existing one has been sown with cotton this year for next year's ratoon cotton, and this will have to be done, every year alternately on the two plots.

Before leaving this crop I may point out, that

- (1) American cotton, though it does well when sown at the proper time, has not a very hopeful field here because (a) of lack of water in the canal at its sowing time, which is earlier than the time for country cottons, and (b) most of the people grow their cotton after removing wheat from the same land.
- (2) The white flowered selections from local Bhatla are likely to do best, being indigenous cottons of the tract. They are also good yielders and have good percentage of lint. Efforts will be made to improve them by selection.
- (3) The cotton of Bhatla village is the best known for seed in this tract. We took our seed from that village in spring 1914. The hailstorm during the month of May, the same year, destroyed most of the cottons of the village, and thus the seed of the old strain of Bhatla with its established reputation became extinct in the village. Now our farm possesses the old strain of real Bhatla cotton.

(6) *Wheats.*—There were 29 $\frac{1}{2}$ acres under different experiments with wheat in addition to three acres under non-experimental wheat. Though the season was unfortunate yet the general condition of the rabi was very fair. The wheat crop was free from rust or lodging.

Tests of Pusa 12 and Pusa 4.—(Statement No. 7.)—There were four acres under these Pusa wheats : the outturns are very good in both cases. Pusa 12 gave the heavier yields : they are both early ripening wheats. Pusa 4 is rather earlier in earing, but Pusa 12 ripened a little before it. The grain is big and plump, but these wheats tiller poorly and more seed per acre is needed. The following are the results :—

Chain harrow.

* *Lever harrow.*

Mds. Srs. Chs.				Mds. Srs. Chs.			
Pusa 4	...	24	8 0	Pusa 4	...	24	7 0
Pusa 12.	...	26	5 5	Pusa 12	...	27	27 5

Lever harrow versus chain harrow.—These were tried. The mulch produced in the case of lever harrow was better than the one produced by chain harrow.

Comparison of different number of harrowings with lever harrow.—This experiment was tried on Punjab 11, but the quality of land being uneven, no reliable results could be obtained.

Experiments with different methods of sowing wheats.—This experiment is of special interest, as the people of this locality sow with "nali" with no "sohaga" afterwards.

This does not allow harrowing or reaping with machine. The following methods were tried in comparison with local method :—

- (1) Country nali with sohaga.
- (2) Munna adjusted with sohaga, *i.e.*, shallow nali with sohaga.
- (3) Poona drill with sohaga were tried against country nali and no sohaga (being the local method).

The experiment was tried in duplicate : as already said the land of block B contains much kallar, and therefore the experiment was repeated in block E. The object was to see the relative germination and no conclusions are made from produce per acre as the soil differs considerably. The general outturns obtained are good.

Germination in case of munna adjusted was best.

Germination in case of desi drill was next followed by the country method.

In case of country nali with sohaga seed went too deep and the germination obtained was bad.

Deep and shallow cultivation as preparation for wheat (Statement No. 8).—This experiment was made in block B, but the land being kallar and uneven it was repeated in block D.

Sabul, Rajah and desi ploughs were used. In both cases Rajah has given the best result.

RESULTS.

FIRST SET.					SECOND SET.				
<i>Wheat.</i>			<i>Bhusa.</i>		<i>Wheat.</i>			<i>Bhusa.</i>	
	Mds.	Srs.	Mds.	Srs.	Mds.	Srs.	Mds.	Srs.	
Rajah ...	26	2	49	38	22	10	34	32	
Country ...	21	16	48	24	21	8	35	2	
Sabul ...	24	11	60	0	19	8	22	27	

Test for comparative yield of four new types handed over by Economic Botanist and Punjab No. 9. (Statement No. 9).—These tests were conducted separately in plots 11, 12 of block E. Each type was grown on quarter acre, but No. 9 was given half acre.

Type No. 20-C gave the highest outturn of maunds 23, seers 36.

Type No. 9 was late in ripening, but gave the good outturn of maunds 21, seers 22.

Miscellaneous.—Seed treated with Antiavit *versus* not treated seed was tried, but as no damage is done here by birds at sowing time, no difference in germination was marked.

2. A plot has been reserved to grow wheat after wheat every year to see how far such practice is harmful.

3. A very small quantity of seeds of all 25 types of Punjab wheats were grown to study habits, etc.

7. *Sugarcane (Statement No 10)*—The five varieties that were selected to be grown on the farm were—

- Mango of Benares.
- Dhoura of Azimgarh.
- Suretha from Samalkha (Karnal).
- Lalri from Samalkha (Karnal).
- Local Ikh.

They gave excellent returns, the outturns varying from over 40 maunds per acre to over 59 maunds per acre of gur : it was prepared with great care and cleanliness. We used Bhindi bark to coagulate the albumin and dirt, and thus the quality of our gur was much better than that of bazar gur. In open bazar banias paid us Re. 1 for 5½ to 6 seers, while the ordinary gur was selling at the rate of 8 seers. The cost was not increased to any appreciable amount, and the success was entirely due to the amount of attention paid in manufacturing, it was a great practical demonstration for the zamindars who greatly liked our gur.

The mango variety ripens very late and therefore the quality of gur in the beginning of January was poor in comparison with that of others, but later on it improved. The local Ikh seems to give a higher percentage of gur from the same amount of juice, but percentage of juice to canes with mango is the highest, while it is least in case of local Ikh. The crop of sugarcane was very satisfactory in spite of the season being dry. These three acres of sugarcane brought us an income of about Rs. 1,000, besides the seed kept for next year.

The crop was heavy and lodged, but was raised several times, and no damage was done to it.

Green manuring for sugarcane with methas versus no manuring.—This was tried. There has been no great difference in yield in case of green manured and unmanured plots except that one small strip of local Ikhr grown on green manured plot gave very high outturns of over 59 maunds of gur per acre.

8. *Gowar* (Statement No 11).—Only the sowing experiments by hand *kera*, ordinary nali and broadcasting were done. The hand *kera* gave the best results. The yield on the whole is from poor to fair, the season being very dry and unfavourable.

9. *Gram*.—Eight acres were grown with gram, six in the wadh of jowar and two in the newly levelled area in block D. The crops were very patchy owing to kallar. Only one irrigation was given. As last year the chopping of tops with sickles *versus* no chopping was carried out. The season was not favourable, and no results in this connection have been gathered.

10. *Japan Sarson* (Statement No. 12.)—Both light green leaved and dark green-leaved varieties were grown for fodder. The light green-leaved has been found the quicker growing, heavier yielding and gave good fodder.

11. *Shaftal*.—This year it has not done well again, and is therefore not suitable for the tract. It wants much water.

12. *Siloing with jowar and barley*.—Two silos were made, one was filled with jowar in the end of August, while the other with barley in the beginning of February. The jowar silo was opened in the beginning of March and came in very handy, when there was a fodder famine in the tract. The silo was quite good and bullocks ate it with relish.

Barley silo was also good, but was not so much liked by bullocks as jowar.

The silo was made in a kacha pit, and no great expenses were incurred. In this tract where there are many cattle, and fodder scarcity not unusual, silos can be made with advantage, provided they are used before the hot weather starts: it is then that fodder is most scarce. The practice can well be encouraged.

13. *Miscellaneous.—Cattle-pound*.—The cattle-pound attached to the farm is working satisfactorily, and a very fair number of stray animals is impounded every month.

Implements.—The wheat drills obtained from Lyallpur were tried; they are doubtless economical, but sometimes get choked and the shares break very quickly in the ground: they require good tilth and fields devoid of clods and roots of trees. The cotton drills proved still less satisfactory. The side of the Rajah fodder-cutter manufactured by Volkart Brothers is too weak, and a small stress while feeding the machine causes it to break; the defect has been pointed out to the firm.

Visitors.—I am glad to say that in spite of the farm being rather inaccessible it is increasing in popularity day by day, and is frequently visited by the neighbouring zamindars. A party of zamindars of the Rohtak District visited it during the year.

DARSHAN SINGH,

Deputy Director of Agriculture, Punjab.

Statement No. 1.

SHOWING THE RAINFALL DURING THE YEARS 1914-15 AND 1915-16 AT THE AGRICULTURAL STATION, HANSL.

1	2	3
Name of month.	Rainfall during 1914-15.	Rainfall during 1915-16.
June	1.23	0.93
July	8.17	1.92
August	2.86	0.12
September	3.48	0.65
October	1.07	0.18
November	...	...
December	...	0.07
January	0.20	0.14
February... ..	2.29	0.21
March	1.53	0.02
April	...	0.05
May	0.60	0.30
Total	20.93	4.59

Statement No. 2.

COMPARATIVE VARIETAL TEST, SHOWING THE RESULTS OF AVERAGE YIELD PER ACRE OF THE COTTON VARIETIES,

Name of variety.	Total area in acres on which grown.	TOTAL OUTPUT.			AVERAGE OUTPUT PER ACRE.			Percentage of lint to un- ginned cotton.	OUTPUT OF LINT PER ACRE.		
		Seers.		Chataks.	Seers.		Chataks.		Mauds.	Seers.	Chataks.
		Mauds.			Mauds.						
Rosa, 87 ...	...	...	22	10	6	16	7	33.3	2	5	8
Mollisoni, 24 ...	...	...	29	4	6	20	14	37.5	2	17	14
4-F. American ...	...	...	20	5	3	39	11	33	1	12	12
Indicum, 135-A (standard) ...	...	...	3	4	5	25	9	27.8	1	22	11
Local Bhatla (mixed) ...	...	...	9	14	5	10	14	33	1	29	10
Sanguineum, 20-A ...	...	...	29	2	4	9	11	33	1	15	15

CULTIVATION.

Rajah plough
Harrow
Horse hoe

Sohaga Weeding Hoeing

Waterings

4

Statement No 3.

COMPARATIVE VARIETAL TESTS OF DIFFERENT COTTONS.

No. of plot.	Name of Variety.	Previous crop.	Area in acres.	DATE OF			ACTUAL OUTTURN.			OUTTURN PER ACRE.			OUTTURN PER ACRE IN TERM OF STANDARD.			REMARKS.	
				Sowing.	First picking.	Last picking.	Maunds.	Seers.	Chataks.	Maunds.	Seers.	Chataks.	Maunds.	Seers.	Chataks.		
4a	Local Bhatla mixed	"	1.12	4th April 1915	19th August 1915.	17th January 1916.	1	13	14	6	5	3	5	20	7	33	hence the cotton outturn was poor. Most of the flowers fell. hoeing = 7, waterings = 7.
4b	Indicum, 135-A	"	"	Ditto	Ditto	Ditto	1	12	12	6	0	1	6	0	1	27.8	
5a	Sanguineum, 20-A	"	"	Ditto	Ditto	Ditto	1	16	2	6	15	7	5	14	2	33	
5b	Indicum, 135 A	"	"	Ditto	Ditto	Ditto	1	5	12	5	8	3	5	8	3	33	
6a	Rosa, 87	"	1.33	Ditto	Ditto	Ditto	1	3	14	5	12	2	5	5	5	33.3	
6b	Indicum, 135 A	"	"	Ditto	Ditto	Ditto	1	1	14	5	2	8	5	2	8	33.3	
7a	Mollisoni, 24	"	1.12	Ditto	Ditto	Ditto	1	4	14	5	4	4	4	33	6	37.5	
7b	Indicum, 135-A.	"	"	Ditto	Ditto	Ditto	1	0	8	4	24	5	4	24	5	37.5	
8a	4-F. American	"	"	5th April 1915	27th September 1915.	Ditto	0	29	0	3	12	0	4	31	0	33	
8b	Indicum, 135-A	"	"	Ditto	19th August 1915.	Ditto	1	3	7	4	37	11	4	37	11	33	
9a	Local Bhatla mixed	"	"	Ditto	Ditto	Ditto	1	10	3	5	28	7	4	28	7	33	
9b	Indicum, 135-A	"	"	Ditto	Ditto	Ditto	0	39	6	4	19	3	4	19	3	33	
10a	Sanguineum, 20-A	"	"	Ditto	Ditto	Ditto	0	16	10	1	35	10	4	23	3	33	
10b	Indicum, 135-A	"	"	Ditto	Ditto	Ditto	1	1	10	4	27	3	4	27	3	33	
11a	Rosa, 87	"	"	Ditto	Ditto	Ditto	1	9	4	5	24	2	4	30	4	33	
11b	Indicum, 135-A	"	"	Ditto	Ditto	Ditto	1	2	8	4	33	3	4	33	6	33	
12a	Mollisoni, 24	"	"	Ditto	Ditto	Ditto	1	6	11	5	12	8	4	27	11	33.	

Statement No 4.

SPACING EXPERIMENT WITH 4-F. AMERICAN COTTON.

No. of block.	No. of plot.	Name of variety.	Previous crop.	Spacing from line to line in feet.	Area in acres.	DATE OF			ACTUAL OUTPUT.			OUTTURN PER ACRE.			Percentage of lint to unginned cotton.	REMARKS.
						Sowing.	First picking.	Last picking.	Maunds.	Seers.	Chataks.	Maunds.	Seers.	Chataks.		
A-1	9a	Cotton, 4-F. ...	Mathas (removed).	4'	1	24th March 1915	9th September 1915.	9th January 1916	5	2	12	10	5	8	33	Germination regular. Good stand of crops all through. Was damaged by locust in August.
	10a	Do. ...	Ditto.	3 1/2'	1	25th March 1915	Ditto.	Ditto	5	15	8	10	31	0	33	Ditto.
	10b	Do. ...	Ditto.	3'	1	Ditto	Ditto.	Ditto	6	2	4	12	4	8	33	Ditto.
	9b	Do. ...	Ditto.	2 1/2'	1	24th March 1915	Ditto.	Ditto	5	10	0	10	20	0	33	Ditto.
A-2	12a	Do. ...	Mathas (ploughed in).	2 1/2'	1	26th March 1915	Ditto.	Ditto	3	34	0	7	28	0	33	Germination regular. The land was in some parts bitter and therefore the plants were stunted in growth. Was damaged by locust in August.
	11a	Do. ...	Ditto.	3'	1	Ditto	Ditto.	Ditto	4	14	0	8	28	0	33	Ditto.
	11b	Do. ...	Ditto.	3 1/2'	1	Ditto	Ditto.	Ditto	6	11	12	12	23	8	33	Germination regular. Good stand of cotton all through. Was damaged by locust in August.
	12b	Do. ...	Ditto.	4'	1	25th March 1915	Ditto.	Ditto	5	13	4	10	23	8	33	Ditto.

CULTIVATION.—Rajah plough = 3, Harrow = 6, Horse hoe = 1, Desi plough = 1, Sohaga = 2, weeding with hand hoe = 1, hoeing with horse hoe = 6, waterings = 6

Name of variety.	Spacing given from line to line in feet.	Number of bits grown.	Total area in acres.	TOTAL OUTTURN.			AVERAGE OUTTURN PER ACRE.			Percentage of lint to unginned cotton.	REMARKS.
				Maunds.	Seers.	Chataks.	Maunds.	Seers.	Chataks.		
Cotton, 4-F. ...	4'	2	1	10	16	0	10	16	0	33	Rajah plough ... 3 Harrow ... 6 Horse hoe ... 1
Do. ...	3 1/2'	2	1	11	27	4	11	27	4	33	Desi plough ... 1 Sohaga ... 2
Do. ...	3'	2	1	10	16	4	10	16	4	33	Weeding with hand hoe ... 1
Do. ...	2 1/2'	2	1	9	4	0	9	4	0	33	Hoeing with horse hoe ... 1 Waterings ... 6

Statement No. 5.

SHOWING THE COMPARATIVE RESULTS OF FOUR TYPES OF COTTON ISOLATED FROM LOCAL BHATLA COTTON.

No. of plot.	Name of variety.	Previous crop.	Area in acres.	DATE OF			ACTUAL OUTTURN.			OUTTURN PER ACRE.			REMARKS.
				Sowing.	First picking.	Last picking.	Mounds.	Seers.	Chataks.	Mounds.	Seers.	Chataks.	
14a	Indicum yellow flowered ...	Cotton	21 44	8th April 1915	19th August 1915	18th January 1916	3	13	14	7	...	8	315
14b	Indicum white flowered (Var. Mollisoni).	Do.	21 44	Ditto	Ditto	Ditto	3	19	12	7	12	14	3688
15a	Neglectum yellow flowered ...	Do.	21 44	Ditto	Ditto	Ditto	4	4	2	3	23	14	317
15b	Neglectum white flowered (Var. Rosea).	Do.	21 44	Ditto	Ditto	Ditto	4	17	1	9	10	14	3488
16a	Indicum yellow flowered ...	Land newly broken.	21 44	1st April 1915	Ditto	Ditto	4	...	10	8	16	9	...
16b	Indicum white flowered (Var. Mollisoni).	Ditto.	21 44	Ditto	Ditto	Ditto	4	17	...	9	10	13	...
17a	Neglectum yellow flowered ...	Ditto.	21 44	Ditto	Ditto	Ditto	4	9	10	8	35	7	...
17b	Neglectum white flowered (Var. Rosea).	Ditto.	21 44	Ditto	Ditto	Ditto	4	11	6	8	39	1	...

Rajah plough = 1, Hattow = 2, Horse hoe = 3, Weeding = 4, Hoeing = 5, Watering = 6, Sowing = 7.
 Germination good in all cases...

Statement No. 6.

RESULTS OF COTTON VARIETIES FOR ENVIRONMENT EXPERIMENT FOR THE ECONOMIC BOTANIST.

No. of block.	No. of plot.	Name of variety.	Previous crop.	Area in acres.	DATE OF			ACTUAL COTTON.			OUTTURN PER ACRE.			OUTTURN PER ACRE IN TERM OF STANDARD.			REMARKS.
					Sowing.	First picking.	Last picking.	Maunds.	Seers.	Chataks.	Maunds.	Seers.	Chataks.	Maunds.	Seers.	Chataks.	
	1a	Mulani (Environment.)	...	1.25	3rd April 1915.	19th August 1915.	17th January 1916.	...	30	11	3	19	10	3	30	24	Germination good all through except in saline patches. Vegetative growth great; damage done by drought and dry winds.
	1b	Indicum, 135-A (Standard.)	...	Ditto	Ditto	Ditto	Ditto	...	35	5	4	...	11	4	...	11	
	2a	Indicum, 133b (Environment.)	...	Ditto	Ditto	Ditto	Ditto	1	6	...	5	9	6	5	19	5	
	2b	Indicum, 135-A (Standard.)	...	Ditto	4th April 1915.	Ditto	Ditto	1	21	1	6	37	15	6	37	15	
	3a	199-F (Environment.)	...	Ditto	Ditto	27th September 1915.	Ditto	...	28	12	3	1	12	5	19	6	
	3b	Indicum, 135-A (Standard.)	...	Ditto	Ditto	19th August 1915.	Ditto	1	4	2	5	...	13	5	...	13	
	1c	Indicum, 133b (Environment.)	...	Ditto	3rd April 1915.	Ditto	Ditto	2	...	...	9	4	2	7	38	7	
	1d	Indicum, 135-A (Standard.)	...	Ditto	Ditto	Ditto	Ditto	2	14	13	10	36	1	10	36	1	
	2c	199-F (Environment.)	...	Ditto	Ditto	27th September 1915.	Ditto	...	29	10	3	14	13	9	21	12	
	2d	Indicum, 135-A (Standard.)	...	Ditto	4th April 1915.	19th August 1915.	Ditto	1	31	15	8	7	7	8	7	7	
	3c	Mulani (Environment.)	...	Ditto	Ditto	Ditto	Ditto	1	15	8	6	12	9	7	36	4	
	3d	Indicum, 135-A (Standard.)	...	Ditto	Ditto	Ditto	Ditto	1	27	13	7	28	10	7	28	10	

Wetland plough = 7, Harrow = 2, Horse hoe = 6, Horse hoe = 2, Solaga = 4, weeding = 1, hoeing = 7.

Rajah plough = 2, Harrow = 6, Horse hoe = 2, Polaga = 4, weeding = 1, hoeing = 7, waterings = 7.

Statement No. 7.

COMPARATIVE RESULTS OF PUSA WHEATS, Nos. 4 AND 12, WITH LEVER AND CHAIN HARROW, DURING RABI 1916.

No. of block.	No. of plot.	Area harvested in acres.	Name of variety.	Previous crop.	TREATMENT.		Method of sowing.	Number of waterings given.	DATE OF		ACTUAL OUTTURN.				OUTTURN PER ACRE.				REMARKS.	
					Before sowing.	After sowing.			Sowing.	Harvesting.	Grain.		Bhuss.		Grain.		Bhuss.			
											Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.		
																</				

Statement No. 8.

RESULTS OF DEEP AND SHALLOW CULTIVATION FOR PREPARING SEED BED WITH PUNJAB TYPE No. 14 DURING RABI 1916.

No. of block.	No. of plot.	Name of variety.	Previous crop.	TREATMENT.		Method of sowing.	No. of waterings given.	DATE OF		ACTUAL OUTTURN.				OUTTURN PER ACRE.				REMARKS.
				Before sowing.	After sowing.			Sowing.	Harvesting.	Grain.	Grain.	Grain.	Grain.	Maunds.	Seers.	Maunds.	Seers.	
B	11	Punjab type No. 14		Country plough = 2 Harrow = 4 Solanga = 3		Seed drilled by Poona drill and solanga afterwards.	3	6 November	4 April ...	21	16	48	24	21	16	48	24	Germination was fairly good, but comes next to plot No. 12 and is better than plot No. 13.
	12	Ditto		Rajah plough 4½" deep = 2 Harrow = 4 Solanga = 3		Seed drilled by Poona drill and solanga afterwards.	3	2 Do.	5 Do. ...	26	2	49	38	26	2	49	38	Germination best.
	13	Ditto	San ploughed in as green manure. Previous to that was a fallow and Banjar.	Sabul plough 9" deep = 2 Harrow = 4 Solanga = 3		Seed drilled by Poona drill and solanga afterwards.	3	1 Do.	5 Do. ...	22	30	56	10	24	11	60	...	Germination least good. Land infected with kallar.
	1	Punjab type No. 14		Country plough = 2 Harrow = 4 Solanga = 3		Seed drilled by Poona drill and solanga afterwards.	3	27 October...	10 Do. ...	16	38	28	2	21	8	35	2	Germination is next to plot No. 2.
	2	Ditto	Banjar.	Rajah plough 4½" deep = 2 Harrow = 4 Solanga = 2		Seed drilled by Poona drill and solanga afterwards.	3	27 Do....	10 Do. ...	21	28	33	37	22	10	34	32	Germination best.
E	3	Ditto		Sabul plough 9" deep = 2 Harrow = 4 Solanga = 2		Seed drilled by Poona drill and solanga afterwards.	3	28 Do....	9 Do. ...	19	8	32	27	19	8	32	27	Germination good, but least good in number in this set of experiment.

Statement No. 9.

SHOWING COMPARATIVE TESTS OF 4 NEW TYPES OF WHEAT HANDED OVER BY ECONOMIC BOTANIST, PUNJAB, AND TESTED AGAINST PUNJAB TYPE No. 9.

No. of block.	No. of plot.	Area harvested in acres.	Name of variety.	Previous crops.	TREATMENT		Methods of sowing.	No. of waterings given.	DATE OF		ACTUAL OUTTURN.				OUTTURN PER ACRE.				REMARKS.		
					Before sowing.	After sowing.			Sowing.	Harvesting.	Grain.		Bhusa.		Mounds.	Seers.	Mounds.	Seers.		Mounds.	Seers.
											Mounds.	Seers.	Mounds.	Seers.							
11	1	Type No. VIII A.	...	Lucerne.	Rajah plough = 1 Harrow = 1 Deep plough = 1 Sohags = 1	Peg-toothed-harrow = 2 Chain harrow = 1.	Dropping seed by hand in the furrows behind the plough, and sohags afterwards.	3	28th October 1915	7th April 1916	4	7	18	13	16	28	73	12	Germination good. Tillering also good: 4ths of the crop was in good condition, while 1th was poor.		
11	1	Type No. VIII B.	...	Ditto.				3	Ditto	Ditto	3	35	17	5	15	20	68	20			
11	1	Type No. XVII B.	...	Ditto.				3	Ditto	Ditto	5	16	8	34	21	24	35	16			
11	1	Type No. XX C.	...	Ditto.				3	Ditto	Ditto	5	39	7	21	23	36	30	4			
12	1	Punjab type No. IX	...	Cotton.				3	Ditto	11th April 1916	10	31	37	9	21	22	74	18			

SHOWING THE RESULTS OF VARIETY EXPERIMENT WITH SUGARCANE DURING KHARIF 1915.

Crop good all
through save
in the two last
plots.

Statement No. 11.

SHOWING THE OUTTURN OF GOWAR GROWN DURING KHARIF 1915.

No. of block.	No. of plot.	Name of crop or variety.	Area in acres.	Nature of experiment.	DATE OF		Number of waterings given.	ACTUAL OUTTURN.				OUTTURN PER ACRE.				REMARKS.
					Sowing.	Harvesting.		Grain.	Bhusa or stuff.		Grain.	Bhusa or stuff.				
									Munds.	Seers.		Munds.	Seers.			
														Munds.	Seers.	
14	Gowar (local)	1	Broad-casting	...	6th July 1915	7th November 1915.	3	6	6	16	15	6	6			16
15	Ditto	1	Ditto	...	Ditto	5th November 1915.	3	6	...	11	35	6	...	11	35	Ditto.
16	Ditto	1	Ditto	...	3rd July 1915	Ditto	3	6	...	12	17	6	...	12	17	Ditto.
17	Ditto	1	Ditto	...	Ditto	4th November 1915.	3	6	36	15	12	6	36	15	12	Ditto.
18	Ditto	1	Ditto	...	Ditto	Ditto	3	7	24	15	9	7	24	15	9	Ditto.
19	Ditto	1	Ditto	...	Ditto	Ditto	3	9	20	17	30	9	20	17	30	Crop poor, little kallar. Suffered from drought.
20	Ditto	1	Ditto	...	4th July 1915	3rd November 1915.	3	8	26	19	35	8	26	19	35	Ditto.
21	Ditto	1	Neel-sowing and no So-haga.	...	2nd July 1915.	Ditto	3	4	25	9	13	4	25	9	13	Crop poor, owing to patches of kallar. Germination poorer than in other cases. Suffered from drought.
22	Ditto	1	Ditto	...	Ditto	Ditto	3	5	15	12	13	5	15	12	13	
23	Ditto	1	Sowing by hand Kera behind the plough and with Sohaga.	...	Ditto	2nd November 1915.	3	9	3	24	20	9	3	24	20	Crop fair. Germination was regular throughout. Suffered from drought.
24	Ditto	1	Ditto	...	1st July 1915	Ditto	3	9	36	25	7	9	36	25	7	Ditto.
25	Ditto	1	Broad-casting	...	Ditto	1st November 1915.	3	9	2	26	27	9	2	26	27	Ditto.
26	Ditto	1	Ditto	...	Ditto	Ditto	3	8	30	30	18	8	30	30	18	Ditto.

Statement No. 12.

SHOWING THE RESULTS OF JAPAN RAPES GROWN FOR FODDER DURING RABI 1915-16.

NAME OF VARIETY.	Area in acres.	Cutting.	ACTUAL GREEN STUFF.		YIELD PER ACRE.		REMARKS.
			Maunds.	Seers.	Maunds.	Seers.	
Green leaved	2	First cutting ...	105	...	140	...	Crop fairly good all through.
		Second cutting ...	54	30	73	...	
		Total ...	159	30	213	...	
Dark green leaved	2	First cutting ...	108	30	145	...	Crop rather thin.
		Second cutting ...	12	3	16	4	
		Total ...	120	33	161	4	

154-8

129-8

2 1/2

3-2

1-9/16

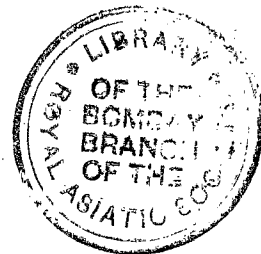
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REPORT

ON THE OPERATIONS OF THE

DEPARTMENT OF AGRICULTURE, PUNJAB,

FOR THE YEAR ENDING 30TH JUNE 1917.



Lahore :

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1917.

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*Proceedings of His Honour the Lieutenant-Governor of the Punjab, in the
Department of Revenue and Agriculture (Agriculture), No. 20500,
dated 7th November 1917.*

READ—

Letter No. 491-50-E.I., dated 6th October 1917, from the Senior Secretary to the Financial Commissioners, Punjab, forwarding with a note by the Financial Commissioner the Annual Report on the Operations of the Department of Agriculture in the Punjab for the year ending 30th June 1917.

ALTHOUGH owing to the war it was not found possible to increase the strength of the superior staff, which is at present undoubtedly inadequate for the growing needs of the Province, still the year was one of steady progress in every branch of the work of the Department which is securing in an increasing degree the confidence of the agricultural population. The next few years will, the Lieutenant-Governor is convinced, see an even greater expansion of its activities. The Punjab's share of the profits accruing to Government from the export of wheat to Europe amounts to Rs. 11,70,000, an extra lakh having been assigned to the Province since the report was written. The Government of India have wisely decided that the whole of this sum is to be devoted to non-recurring expenditure for the benefit of the agricultural classes. A tentative programme of expenditure, to be spread over several years, has been drawn up, which will eventually bring the department into close touch with large tracts now virtually outside its scope. Several of the more ambitious projects must inevitably wait till the extra staff required for their supervision can be provided, but with others, such as the acquisition of land for experimental dry farming in the north Punjab, the establishment of a number of demonstration farms for the benefit of District Boards, the necessary extensions of buildings and the provision of pure seed on a much larger scale than heretofore, an immediate start will be made.

2. The Lyallpur College after several years of vicissitudes is now firmly established in popular esteem. Four years ago popular opinion as to the value of the College courses and the expansion of the department was so low that there was not a single application for admission. In 1916 the number of applicants was 138 of whom only 38 could be admitted, and in 1917 there were 202 applications for 40 vacancies. The causes contributing to this increased popularity are summarized in paragraph 2 of the report as firstly, the knowledge that the College is the stepping-stone to an honourable and well paid career in Government service, secondly, the recognition by the landowning classes that a course at the College is the best possible training for youths who will have to manage their own estates, and thirdly, the growing attraction of a purely scientific education for students who mean to devote themselves to research. In fact, the Director now finds it difficult to cope with the applications from large estate owners for the services of men trained in the College. All these are grounds on which the Director and his staff may fairly congratulate themselves, but the greatest share in the credit must, in His Honour's opinion, be assigned to the late Mr. J. H. Barnes, the value of whose work, both as Principal of the College during the early critical years of its existence and as Agricultural Chemist, can hardly be overstated. He has left an enduring mark on Punjab agriculture, and Sir Michael O'Dwyer agrees with the Director and the Financial Commissioner that the Province has suffered a great loss by his untimely death.

3. His successor, Mr. Roberts, has assumed charge at a moment when important changes are imminent. The affiliation of the College to the Punjab University and the establishment of a degree in agriculture now only await the completion of the necessary formalities regarding which it is understood that the Director is communicating with the University authorities. In anticipation of these changes, which will give the College an assured position among

the higher educational institutions of the Province, the curriculum has recently been remodelled with the approval of Government. The course for a degree will last for four years, but a certificate will be given to those who have completed a two years' course but do not wish to take a degree. The creation of three new assistant professorships has been sanctioned and certain additions have been made to the subordinate staff; but the Lieutenant-Governor entirely agrees with Mr. Maynard that the Professors should continue to take on adequate share in the teaching and in the guidance of the practical work of students. Their influence and example must remain the dominant factors in training and turning out men worthy of the College and of the great interests for which it stands.

The growing popularity of the short English course for Revenue and Irrigation officers and of the six months' vernacular course is encouraging. The Lieutenant-Governor considers that in the Punjab the latter course provides the most effective means of popularising improved methods among practical agriculturists, and in view of the great number of applicants who have now to be refused at Lyallpur he would like to see a similar course arranged for at the Gurdaspur farm.

4. The successful completion of the Narwala reclamation experiment marks an important stage in the solution of a problem of enormous importance to Punjab agriculture. Whether the improvement will be permanent remains to be seen, and as Mr. Maynard observes the future history of the Narwala farm should be carefully watched. The scheme for the reclamation on similar lines of a very large area of saline land on the Lower Bari Doab canal has been submitted for the sanction of the Government of India. Expert opinion is not altogether unanimous on its prospects of success, but the Lieutenant-Governor feels that the issues at stake are of such importance that Government should not be deterred by the risk of failure from making an experiment which will cost a few lakhs of rupees, but which, if successful on a large scale, will add some millions sterling to the capital wealth of the Province.

5. His Honour has read with interest the account printed as appendix III of the report of the experiments in American cotton and wheat conducted by Mr. Milne, the Economic Botanist. While recognising that these furnish most valuable data for further progress, he agrees with the Director that exhaustive tests by the Agricultural officers are necessary, before the Department can safely advise zamindars to substitute new varieties for such well established favourites as American 4-F cotton and Pusa 11 and Punjab 12 wheats. The continued success of Mr. Roberts and his assistants in pushing the cultivation of these popular varieties is most striking. The area under 4-F cotton in 1917 is estimated at 225,000 acres, or more than quadruple that of 1916, and the Director calculates that the extra profit to the cultivators from sowing this variety will amount in a single year to the enormous sum of 45 lakhs of rupees. But in the near future each year's results may be expected to surpass those of its predecessor. The investigations of the recently formed committee on long stapled cotton should add materially to our knowledge of the subject, while with improved ginning factories and market accommodation the separation of long and short staples will be facilitated. Moreover, as the Financial Commissioner remarks, the scientific study of transport and marketing conditions is a subject that has as yet hardly been touched. But the arrangements now being completed for posting Bombay and Lyallpur prices at the principal provincial cotton markets are a step in the right direction, and should tend to secure better prices for the cultivator.

The area under Punjab 11 wheat in the three great canal colonies last winter was 97,000 acres, as compared with 27,500 acres in the rabi of 1916. The extra profit accruing to the zamindars on these 97,000 acres according to the Director's conservative estimate is at least two lakhs of rupees. Next year the area under this wheat will be appreciably higher, some 1,200 tons of seed having been bought by the Department for distribution.

6. The work of Mr. Brownlie, the Agricultural Engineer, has been greatly handicapped by the high prices prevalent throughout the year and the difficulty of obtaining imported materials. In the circumstances it is satisfactory to learn that 538 wells were bored as compared with 346 in the previous years, and that the number of large diameter tube-well installations completed rose from three to six. Two of these were for private landowners. In several cases borings had to be abandoned when success seemed assured owing to the well owners being unable to pay the cost of completing the operation, and in such cases the Director might endeavour to arrange for a *takkavi* advance to be given through the district authorities. Mr. Brownlie has also done valuable work in designing improved agricultural implements and grain-bins.

7. In spite of the great rise in prices there was a satisfactory increase in the number of implements sold to cultivators. It is an encouraging sign that several co-operative societies are now acting as agents for the manufacturers of the Meston plough, and that country blacksmiths are imitating the improved harrows and other implements introduced by the Department. Mr. Roberts' discussions during his recent leave with manufacturers in England and America have resulted in the experimental production of a new plough, which promises to be even better adapted to Punjab conditions than the Meston plough.

8. The areas of both the Lyallpur and Gurdaspur farms have recently been increased, and the necessary additions to the staff have been sanctioned. His Honour concurs with Mr. Maynard in thinking that the policy of organizing visits to the Lyallpur farm and college might usefully be extended. The admirable work—scientific and practical—that is being carried out there is at present mainly known to those who have a direct personal concern with agriculture, and it is very desirable that all who take an intelligent interest in the development of the Province should have an opportunity of being brought into touch with it. For the accommodation of the increasing number of visitors to the Gurdaspur farm a *serai* is about to be built. The Lieutenant-Governor visited the farm last March and was impressed by the value of the work done by Deputy Director in charge, M. Fateh-ud-din. Some of the outturns of unirrigated wheat at this farm were astonishingly high and show what results can be obtained even in an exceptionally dry season by deep cultivation, careful weeding and conservation of moisture by constant harrowing. The outturns obtained by a single watering before sowing, and by two waterings are also remarkable and the Lieutenant-Governor is glad to see that experiments on similar lines are being made by some large landowners in the canal colonies. They have also been brought to the notice of the Irrigation Department which is arranging to pursue the enquiry in a practical manner. The Hansi farm, which is managed by Sardar Darshan Singh, Deputy Director, is so far less successful, experimental work being handicapped by the uneven quality of the soil and a rather uncertain irrigation supply.

9. Olive culture is discussed in paragraph 10 of the report and paragraph 9 of the Financial Commissioner's review. Mr. F. J. Mitchell, who has hitherto been in charge of the experiments in Khairi Murat and Ghandala, has been unable to accept the terms of the lease offered him by Government, and it has now been decided that the Khairi Murat plantation should be managed by the Forest Department. That at Ghandala, where the soil is unsuitable, will be given up.

10. As the Financial Commissioner remarks, one of the most gratifying features of the report is the instances it gives of ready co-operation by the officers of the Department with other branches of the administration. With District and Colonization Officers, agricultural associations, business firms, large proprietors and peasant owners the relations of the Department are equally cordial, and its continuous and increasing success in recent years is largely the result of this attitude. The Lieutenant-Governor agrees with Mr. Maynard that Mr. Townsend's personality is primarily responsible for the existence of these happy conditions. His administration of the Department throughout his three years of office has been conspicuous for energy, tact and

sympathy, and he has benefited materially from the broad and sympathetic outlook of the Financial Commissioner, Mr. Maynard.

This is the last occasion on which Sir Michael O'Dwyer will review the work of the Department, in which during the last five years he has taken a close personal interest, and he congratulates the Director and his expert assistants on a record of uniform success and on a future of even greater promise.

ORDER.—Ordered that a copy of these remarks be forwarded to the Senior Secretary to the Financial Commissioners, Punjab, for the information of the Financial Commissioners, that they be published in the *Punjab Gazette* and submitted with copies of the report to the Government of India, Department of Revenue and Agriculture. *

By order of His Honour the Lieutenant-Governor of the Punjab,

H. D. CRAIK,

Revenue Secretary to Government, Punjab.

Financial Commissioner's note on the report of Agricultural Department for 1916-17.

1. The growing popularity of the Lyallpur Agricultural College is shown by the increasing applications for admission, 138 in July 1916 (and 200 in the following year) as against 38 vacancies. The plan of affiliating the College to the Punjab University (to which formal effect has not yet been given) has already borne fruit in the remodelling of the curriculum in consultation with Lieutenant Colonel Stephenson, I.M.S., Principal of the Government College. The success of the instruction given has been established by the highly commendatory remarks of the external examiner. It shows what results can be attained when the proportion of teachers to students is a high one. The Financial Commissioner thinks it of great importance that the Professors, a substantial portion of whose time is taken up in research or in dissemination, should also take an adequate share in the teaching and in the guidance of the practical work done by students. The student will realize that knowledge is a living and growing thing, to which he himself may some day be able to add, if he is brought into contact with the workings of a mind which is engaged in making additions to it. This is the means by which interest may be awakened and maintained and the germs implanted of a taste for research.

2. That there exists a proportion, however small, of the students, who intend to use the education received as a means of fitting them to manage their own estates, is a fact full of promise. When the new block of boarding quarters, built on the model of a block at the Aitchison College, is completed, the Financial Commissioner will hope to find Wards of Court and others of the landowning and aristocratic classes attending the College.

3. The vernacular class, which is now attended by a certain number of Court of Wards employees and will next year also be attended by some officers of the Co-operative Department, is in very great demand, and more than three-fifths of the applicants have to be turned away. The Financial Commissioner recognizes the importance of training teachers for the new proposed type of Agricultural School and the possibility that this need may out from the vernacular class the others who now attend it. But the teaching which could be given at Gurdaspur or elsewhere would so certainly be less effective than that which is now given at Lyallpur, that he would greatly regret the limitation of the Lyallpur class to prospective teachers only, if provision could by any method be made there for others also.

4. The completion of the reclamation of the alkaline land at Narwala is an important feature of the year's history. It now remains to watch carefully the agricultural history of this land and to collect data for estimating the period likely to elapse before the salts begin to reappear in land which is subjected to this treatment. The Financial Commissioner understands that systematic arrangements have been made for this purpose, and he thinks that a careful record ought to be kept of each season's crops after inspection by the Deputy Director of Agriculture. On the duration of the cure at Narwala depends important deductions regarding the efficacy and financial value of similar measures elsewhere.

5. There is no finality in the selection of any particular variety of plant, and the steady work which Mr. Milne, the Economic Botanist, is doing in testing numerous varieties may some day bear fruit in the production of something better than the department now has available. Mr. Milne's 8-A wheat for instance appears to promise well, though it has yet to be subjected to further tests. For the present, 4-F American cotton and Punjab 11 wheat in the perennially irrigated Central Punjab and Pusa 12 wheat on the well lands of the submontane districts hold the field. There

can be little doubt that the cultivators' appreciation of the last-mentioned variety answers conclusively the criticisms which have been passed upon it. The scale upon which the seed of varieties approved by the department (over 200,000 acres of 4-F cotton and 100,000 of Punjab 11 wheat) is grown is a testimony of a striking kind to the extension of its influence. With Government advances to finance the holding of larger quantities of seed this feature of its activities will become even more prominent.

6. The manurial experiments are less important than the varietal, owing to the fact, now apparently demonstrated, that they do not pay. The financial results of this class of experiment are clearly shown in the tabular results appended to the Gurdaspur report : and it is desirable that they should also be exhibited for the Lyallpur Farm.

7. The department continues to press such simple and well-proved reforms as the sowing of cotton in lines and the subsequent interculturing of it, and to work out simple and cheap improvements of ordinary agricultural implements, such as the bar harrow, in the Lyallpur implement yard. It is interesting to see, in a radius of a few miles round Lyallpur, substantial cultivators adopting the department's methods, and even interstripping their cotton sown in rows with cotton sown broadcast, in order to verify the advantage of one method or the other. Valuable lessons can be drawn for future schemes of colonization by taking note of the type and class of cultivator who shows himself most ready to learn and to profit, and also by recording the names of individuals who have proved their enterprise. It would seem that the small man is too poor and narrow-minded : the big man sometimes too careless and too often an absentee : while the man with three or four squares, which he works himself, is often a valuable agent for the popularisation of the department's methods. But the capitalist—even when he belongs to the non-agricultural class—is, when he attends to the business, also a most valuable helper, and there is a regimental estate not far from Lyallpur which may almost be said to have served as a demonstration farm.

8. The policy of organizing visits, particularly to the Lyallpur Farm and College, may with great advantage be carried further than at present. Practical cultivators will there see something which some of them may afterwards apply : and Mr. Maynard would occasionally include among the sight-seers Hon'ble Members of Council, journalists, professional men, and University students. What they would there see would answer beforehand some of the criticisms now passed upon the policy of Government, and answer them more effectively than any official reply.

9. The remarks on olive culture in paragraph 10 of the report leave the Financial Commissioner with the impression that there is some vagueness as to the responsibility for these experiments. It seems to him that either the Forest Department or the Agricultural Department should assume responsibility for them. It is interesting to hear that the Salvation Army, whose Silk School at Simla now has 20 students, distributed 463 ounces of silkworm seed, in addition to 700 otherwise distributed. Both fowl-breeding and sericulture should have futures before them, but apparently the interest taken by the people in both is small at present.

10. There was a satisfactory increase from 346 to 538 in the number of ordinary wells bored by the staff of the Agricultural Engineer, Mr. Miller-Brownlie. A light power boring plant has been ordered ; but all this work is hampered by high prices and scarcity of materials. The Financial Commissioner desires particularly to acknowledge the personal attention which Mr. Miller-Brownlie gives to the College students in their work at the smithy and the carpentering bench.

11. There are great possibilities in the study, as yet hardly touched, of the conditions of the transport of produce and of methods of marketing, and the Financial Commissioner looks forward to the establishment at some date of a chair of Agricultural Economics in the Agricultural College. In connection with cotton-ginning and marketing, some agricultural officers met, during the year under report, representatives of the great exporting firms, Indian growers and dealers, and revenue officers, and considered measures for preventing the mixture of long and short staple cottons and for securing an adequate price for Punjab American cotton in the wholesale market. As a result of these deliberations, steps are being taken to post Bombay and Lyallpur prices in the principal markets : to provide for the scrutiny and approval of the plans of new ginning factories by the Professor of Agriculture : and for the construction in the Lyallpur District of a cotton market with accommodation sufficient to protect the producer against his present complete dependence upon the ginner. To the public sales of American cotton organized by the department (which have been attended by representatives of Japanese and Bombay firms, as well as agents of the exporting houses) reference was made last year. There have been occasional instances of bad faith on the part of producers, sometimes important men who should have known better. But the punitive measures taken by the buyers have probably had an educative effect.

12. During the year the Agricultural Department assisted the Sanitary Board in an enquiry into the conditions of Municipal Sewage Farms, which is still proceeding, and work was done by the Agricultural Chemist on the investigation of the iron bacteria which injure certain supplies of drinking water. On behalf of the Irrigation Department the percolation of water from canal channels and from field surfaces was investigated, and plans for the systematic ascertainment of methods of water saving are now being considered. A joint session of Agricultural and Co-operative Department officers was held at Lyallpur, and arrangements devised for the interchange of instruction in matters agricultural and co-operative, so that the agricultural officer may know something of the principles of co-operation and the co-operative officer may help to give effect to the improved methods which the agriculturist has proved to be efficacious. A first result of this is the starting of six demonstration plots by co-operative societies in Gurdaspur. Agricultural officers also met agents of the exporting firms and officers of the Land Records Department and district staff to devise improvements in the existing method of preparing crop forecasts, particularly for the great export staples of wheat cotton and oil-seeds.

13. The most promising feature of the Agricultural Department is its readiness to co-operate with other departments of Government, with the district staff, with the business man, with the large estate owner, and with the cultivator : to co-ordinate enquiry, to criticize obsolescent methods, to interchange knowledge, to adjust improvement to capacity, to learn as well as to teach. Mr. Maynard is clear that the broad and tolerant personality of its Director, Mr. Townsend, has been no small factor in the creation of these harmonious and hopeful conditions.

14. In Mr. Barnes, whose transfer to Pusa as Imperial Agricultural Chemist, was followed by his untimely death, the Agricultural Department and the Lyallpur College have suffered a heavy loss. The large and enterprising outlook, the wide knowledge, and indefatigable energy of this officer promised great results, of which a part had already been realized in the rehabilitation of the Agricultural College and the initiation of enquiries of vast potential importance to agriculture. A few weeks before his death he presented to a conference of officers a scheme based upon the measures which were successful on a small scale at Narwala for the reclamation on a great

scale of alkaline lands in the Southern Punjab ; and his study, in connection with the Irrigation Engineers, of seepage problems made him a valued member of another conference which made proposals for the systematic investigation of the problems of water-logging by a permanent Seepage Board.

15. The Financial Commissioner cordially endorses the Director's appreciation of the work of Mr. Roberts, Principal of the College and Deputy Director of Agriculture in the Lower Chenab and Lower Bari Doab Colonies. Mr. Roberts brings to his work a mind enlarged by recent travel, and personifies that admirable caution which secures confidence by pressing upon attention only the tried and proved benefit.

Notice of Mr. Roberts, Principal, Agricultural College.

16. The Agricultural Department is still only at the beginning of its achievements, with some sections of the Province still almost untouched, with many problems yet to solve, and many converts yet to make : but a great beginning has been made and in the wise tradition which is being established, and in the hearty response which the Punjabi cultivator in the more fully exploited districts shows signs of making, lies the hope of a greater future. It claims, and has, the Financial Commissioner is glad to acknowledge in a large measure received, the consideration of Government, when its growing and sometimes unforeseen demands may have been disturbing to the smooth course of financial routine. But it has for its apology the contribution to war needs of increased supplies of foodstuffs and cotton, and some solid additions already made to the wealth of the Province, of which the sum of 40 or 50 lakhs added to the value of a single season's cotton crop, is the most remarkable. The splendid accession of Rs. 10,70,000, granted for non-recurring agricultural expenditure out of the profits on the export trade in wheat, provides the means of a wide extension of its activities as more staff becomes available. With the establishment of a dry cultivation farm in the Northern Punjab, and of several new demonstration farms which are projected, areas now virtually outside of the Department's scope will come within it, and a more nearly equal attention to all portions of the Province, the well lands of Jullundur and Hoshiarpur, the inundation canals of the south-west, the rain lands of the submontane tracts, may be expected.

17. The Financial Commissioner endorses Mr. Townsend's thanks to the officers of other departments, particularly Messrs. Kitchin, Joseph and Calvert : and he feels that he must add an acknowledgment to the enlightened estate owners who have assisted the cause by their enterprise among whom Rai Bahadur Ganga Ram, C.I.E., is prominent.

Notice of help from outside the department.

H. J. MAYNARD,

The 26th September 1917.

Financial Commissioner, Punjab.

E R R A T A.

Paragraph 6, page 2, line 56, *for* mulbery *read* mulberry.

Do. 6 „ 3 „ 2 „ mulbery *read* mulberry.

Do. 10 „ 5 „ 3 „ ormer *read* former.

Appendix I, page i, line 27, *for* comma after sprang *read* comma after up.

Do. III „ vi „ 1 „ Then *read* Ten.

Do. III „ vi „ 15 „ cambodla *read* cambodia.

Do. VI „ xiv „ 32 „ anticipateds *read* anticipated.

Do. VI „ xvii „ 39 „ hailed *read* hail.

ANNUAL REPORT

ON THE

DEPARTMENT OF AGRICULTURE, PUNJAB,

FOR THE YEAR ENDING JUNE 30th, 1917.

1. The only important change in the staff that occurred in the year under report was the departure from Lyallpur of Mr. J. H. Barnes, Principal of the College and Agricultural Chemist, for Pusa, where he had been appointed Imperial Agricultural Chemist. He died shortly after his arrival there. In both the capacities mentioned he did excellent work for the Province, and his early death is a very great loss to India. He has been succeeded as Agricultural Chemist by Mr. B. H. Wilsdon, from the Government College, Lahore, and as Principal by Mr. Roberts, Professor of Agriculture, who returned from his tour in America. To assist Mr. Roberts in his heavy duties, Mr. Faulkner, Deputy Director of Agriculture, is for the present remaining on at Lyallpur; he or some other Agricultural officer will undoubtedly have to remain there permanently as assistant to Mr. Roberts. M. Fatteh-ud-din, Assistant Director of Agriculture, continues to hold charge of the Gurdaspur farm. Of Mr. Southern—*vide* paragraph 1 of last year's report—there is no news.

2. The report of the Principal of the College will be found in Appendix I. Thirty-eight students—the full number admissible—joined the College in July 1916, for the English course: there were also then 20 students in the second year, 7 in the third year, and none in the fourth year: the reason for this last was that no students joined the College in 1913. The usual one month's English course for Revenue and Irrigation Officers, and the six months' Vernacular course were also held: 20 students attended the former course, and 30 the latter. The candidates for admission to all these classes, especially the last, were much more numerous than the vacancies. It will be certainly necessary, I consider, to start another Vernacular class in the near future, so keen is the demand for admission to the present class.

The external examiner in Agriculture, Mr. Knight, Professor of Agriculture at Poona, reported very well indeed on the students' attainments in that subject. On the other hand, Mr. Chawla, the external examiner in Mathematics, did not think the mathematical syllabus entirely suitable. Effect is now being given to this criticism, and others of the same nature, in a recent remodelling of the curriculum: mention however of this will come in next year's report.

The affiliation of the College to the University has been, practically, decided on. It appears to me that both the College and the University will benefit by the affiliation.

I am not infrequently asked why the College course has become so much more popular than it was a few years ago: in 1913, as said above, the College attracted no students. Briefly, I attribute this to two main reasons. The first is that the College now leads on to a definite and well paid career in Government service: the second is that the land-owning classes now realise that a training at the College will render their sons more fit to manage their estates than would have been the case otherwise, and that the possibilities of improved agricultural methods in the Punjab are not small. A third reason, just beginning to show itself, is that the College now gives a good scientific education, and is slowly beginning to attract those students who are keen on

research in itself. At present the first of the reasons given above is the most powerful: but the second is also daily getting more so. Among the students at the College is a son of a member of the Imperial Legislative Council, who will manage his own estate on leaving it.

The number of applications I receive from private employers, both English and Indian, for men who have passed through the College to manage their estates is daily increasing. I do all in my power to satisfy such demands.

Steps are being taken to add to the boarding house accommodation at the College a superior type of boarding house, designed to accommodate lads who have passed through the Chiefs' College at Lahore.

3. See appendix II. The Narwala reclamation experiment—see paragraph 3 of last year's report—has been successfully concluded during the year, and the land restored, cured, to its original owners.

Chemical research.

Reclamation took about three years, and cost about Rs. 30 per acre plus an undetermined charge for extra water. The value of the land treated has been increased from about Rs. 45 to Rs. 250 at least per acre. Government has now under consideration a proposal to apply the methods proved successful at Narwala on a considerably larger scale to kallar lands in the new Lower Bari Doab Colony.

Mr. Wilsdon has entered on his new duties with zeal.

4. Appendix III contains an interesting account of the work on which Mr. Milne, the Economic Botanist, is engaged. Some of his wheats and cottons, are very promising, and, it may well be, will supplant eventually 4 F American cotton and Punjab 11 and Pusa 12 wheats, which we are at present pushing in the Province. But the time for that is not yet; the possible "supplanters" are at present being carefully tested, from every point of view, by the Agricultural Officers, and these tests must continue for some time more.

Botanical research.

A monograph on date palms by Mr. Milne is in the press. The Arabian dates continue to do very well, though the crop suffered much, as did country dates, from the unusually heavy monsoon of last year. The Scotch potatoes in the Simla Hills continue to be extremely popular and successful; they generally yielded from 50 to 75 per cent. more than neighbouring country potatoes; in not a few cases the difference is more than 100 per cent. in favour of the Scotch variety. Some four acres is being grown with them this year. The comparative smallness of this area is due altogether to the limited amount of seed potatoes we had last year. It will certainly expand rapidly now as more of these become available.

5. See appendix IV. The cotton bollworm attack was slight. The usual measures were taken to deal with it. The criticism has recently been passed on the distribution of the bollworm parasite—the usual step we take when bollworm attacks are reported—that the evidence that the parasite really destroys the bollworm is very slight. I am examining the point.

Entomology.

For the pests that damage mango trees, especially in Hoshiarpur, the most hopeful line of attack appears to be the thinning out of the existing mango groves and the breaking up of the soil around the roots of the remainder, so as to produce stronger and healthier trees.

6. See appendix IV. Seven hundred ounces of silkworm seed were distributed, as against 575 ounces last year. This is in addition to 463 ounces distributed by the Salvation Army. The prices realized by the rearers for their cocoons were good, and the industry is slowly spreading, as a cottage industry, among the poorer classes in the submontane tracts. Experience has shown that it is very inadvisable to give a monopoly of the mulberry trees, and therefore of the sericulture, in any one district, or even tahsil, to any private individual. Such monopolies nearly always result in the rearers getting

Sericulture.

a less price for their cocoons than they should. Steps are being taken to put down more mulberry plantations in the principal sericultural districts. It is worthy of note that the Salvation Army at their Changa Manga Settlement abandoned the wholesale rearings it went in for last year, and instead got the neighbouring villages to hatch some seed. This is much more hopeful line of action.

The Salvation Army Silk School at Simla is doing fairly well. It has at present 20 students, nine of whom come from the Simla Hill States.

7. Full details of the work done by Mr. Brownlie, the Agricultural Engineer, will be found in appendix V. With a staff of the same size, the number of wells in which borings were made increased from 346, in the preceding year, to 538 in the year under report. The percentage of wells successfully bored was very slightly higher than last year: it is about 70 per cent. So pleased is the Multan district board with the improvements effected in wells by our borers there, it is anxious to entertain a special boring establishment of its own. Six tube well installations were completed during the year. A light power boring plant has been ordered and should arrive shortly; and a new workshop for the Agricultural Engineer has also been sanctioned. But all his work is being greatly hampered by the great, and increasing, difficulty of getting supplies from England, and by their greatly enhanced prices, compared with pre-war rates, when they do arrive. This difficulty is particularly felt in preparing estimates for installations for private individuals.

8. I have nothing to add to what was said about this unimportant branch of work in paragraph 17 of last year's report. The Leghorns at Gurdaspur continue to be in considerable demand locally.

The following is an extract from a note on the poultry in the Lahore Zoo sent me by the Deputy Commissioner of Lahore:—

"Certain breeds are kept in stock for the supply of eggs to private breeders. The idea of starting the poultry farm was mostly to stimulate Indians to keep a better breed of fowls, but unhappily it has never 'taken on' satisfactorily. A very few Indians have purchased young chickens, though a considerable favour has been shown them in allowing them to purchase at cheap rates.

"The Lahore Poultry Show was held in February 1917. All breeds were well represented, and exhibits came from all parts of India. The white Leghorn breed is now looked on as one of the best breeds. It is a veritable laying machine, non-sitting and easy to rear. One Leghorn hen lays more in half a year than four desi fowls would in one year. But it is a pity that Indian fanciers will not take to this breed."

9. During the year the weather conditions were far from ideal for bee keepers, the prolonged rains of 1916 being disastrous for weak colonies, but matters improved somewhat in April this year. Mr. Cousins has now 14 hives, all doing fairly well.

His apiary was removed from Sanawar to Kasauli in November 1916, and the change of locality has proved advantageous. His experiments have conclusively proved that in the matter of comb foundation there is nothing equal to the article used by English and American bee keepers.

During the year Mr. Cousins delivered two lectures in his apiary to parties of school children from Sanawar. On numerous occasions villagers and other persons visited his apiary, and he gave them practical demonstrations of the facilities with which bees may be manipulated in modern frame hives. Lala Madan Mohan Lal, Assistant Professor of Entomology, Lyallpur, and Mr. P. R. Awati, B.A., F.E.S., Entomologist to the Indian Research Fund Association, also paid him visits. Mr. Cousins toured in Simla and the neighbouring hill states and demonstrated to many gatherings of the Hill folk the advantages of modern bee culture. The state authorities gave him every assistance.

Letters regarding apiculture from all over India were received and answered. Copies of "Guide to Bee-keeping" by Mr. Cousins were sent to enquirers; the publication of this pamphlet has considerably reduced the lengthy correspondence of previous years. The advisability of translating it into Urdu is receiving my attention.

The Simla Bee-keepers' Association continues to exist and is financially in a very sound position, but its members might well be keener than they are.

Despite indifferent weather conditions Mr. Cousins was successful in getting some well filled sections, proving that, even with the indigenous bee, good comb honey, so common and so much appreciated in England, can be obtained in India. The possibilities in this direction in the Punjab hills with European bees are very attractive. The introduction of Italian bees has not yet been accomplished through the failure of the Agricultural Department of New South Wales to despatch fertilized Queens in February last—probably due to the war.

10. Mr. F. J. Mitchell, who is in charge of the olive cultivation in the Jhelum and Rawalpindi Districts—the department has nothing to do with it—sends the following note as regards it:—

Olives.

"During last cold weather I twice visited Khairi Murat, once early in December (1916) and again in February, and was much pleased with the careful work put in by Fazl Dad, the mali, of which every part of the garden gave evidence. The production of fruit from the locally planted trees had only slightly increased, but the feature of the season was the great crop of fruit on two small trees which were imported from Marseilles in 1912 and which had not previously borne fruit. These trees, to a certain extent, have had the advantages which trees on cultivated ground in Southern Europe would have, except that they have been much too closely surrounded by seedlings, which no doubt have taken much of the nourishment which was their due.

"A friend writes to me from Leghorn that the yield of nearly 20 lbs. from one of those trees, only 4 years *in situ*, is regarded in Italy as phenomenal. He also adds that the latest tendency of olive growers in that country is towards keeping the olive trees small, like small fruit trees, from which the fruit can easily be picked without damage.

"In this connection I would like to refer to the success achieved by Mr. Robertson Brown at Taru, North-West Frontier Province, with 100 plants I got for him from Italy in the spring of 1912. They were planted (rather close together) in fair agricultural land, and have made wonderful growth. I think 97 per cent. have been successful, and all are now approximately 13 feet to 14 feet high with heavy growth, which this last winter was pruned back for the first time. Nearly all bore fruit last year, one tree producing a little over 20 lbs. of excellent olives which I think were kept for seed. Of course none of these trees were loaded with fruit as were the little trees at Khairi Murat, but that was not to be expected from trees making such growth.

"These results, associated in my mind with the experiences gained at Gurhi, Kashmir, lead me strongly to the impression that it may be possible to get a better yield of fruit from selected varieties grafted on the O. Europaea stock than from the same varieties grafted on the O. Cuspidata stock. To get a satisfactory showing on this point it will be necessary to give experimental trees of each grafting similar advantages of soil and water, in the same way that similar experiments have been made with oranges and other fruit at Taru and other Agricultural Stations. Hitherto the grafted Cuspidata has had not chance of showing what it can do on good soil, and no imported tree has been planted on the rocky soil on which the wild olive of India flourishes."

"The following figures relating to the progress made in Khairi Murat this year are interesting:—

New olive trees, budded and grafted	...	...	...	306
Olives (grafted and European) in area	...	...	...	15,114
			Mds.	Srs.
Fruit produced	...	...	...	2 15

"My visit to Gandalla was rather shorter than I had intended, but my inspection of the garden fully bore out the impression I had formed of its capabilities in preceding years. The

flat ground is most disappointing, and, in spite of the excellent soil analysis, practically none of the trees make any substantial progress. The results achieved are comparable to those of the former Forest plantation of Sissoos, (which on the same ground in 30 years produced no trees of importance); and I can only think that the soil is too porous to retain sufficient moisture for successful arboriculture of any kind, unless with a full head of irrigation. No doubt the browsing has had a very bad effect, and in this respect the almonds have been the greatest sufferers, but a very great proportion of the young olive trees are wind blown and show bark disease near the roots. The best trees are those either near the edge of the plateau, where the roots have been able to get to the moist soil near the stream, or where the soil shallows on to the limestone rocks, down which no doubt some moisture at times trickles. It is a pity some of the trees right up on these rocks were not grafted, so that the results might have been compared with similarly placed trees at Khairi Murat. As an experiment of growing olives on agricultural ground with the benefit of some irrigation, however, I fear Gandalla is a failure, and it must rest with the Forest Department to decide whether they will leave the trees to try and push their roots through the 30 feet or so of dry soil that is between them and moisture, or accept a proposal that I understand has been made them by Lala Ramjee Das and allow him to try and grow roses on this area. Possibly the profitable nature of that industry may overcome the difficulty of bringing in full irrigation from the stream."

11. Despite the continued rise in prices—some implements cost now nearly 75 per cent. more than they did before the war, and some, as chaff-cutters, are unobtainable—
 Implements,
 it is satisfactory to find that the number of improved agricultural implements of all kinds that are imported from Europe or America; sold in the Province during the year under report, shows an increase of about 40 per cent. on the number sold during the 1915-16. Here are details:—

<i>Name of implement.</i>	<i>Sold in 1915-16.</i>	<i>Sold in 1916-17.</i>
Raja ploughs	202	379
Meston ploughs	906	1,264
Other ploughs	79	92
Hoes	13	10
Harrows	55	56
Fodder-cutters	58	42
Miscellaneous (grain kibblers, reapers, mowers, winnowers),	10	20
Total	1,323	1,863

The system referred to in paragraph 12 of last year's report, by which Co-operative Societies in the Central Punjab districts stock Meston ploughs for sale, as sub-agents for the firm supplying them, has been adopted by about 20 of these societies, and is working satisfactorily. The Bhainimilvan Union (Gurdaspur District) sold 270 Meston ploughs and 100 shares in the year. More could have been sold had the firm been able to supply more. In the Bet (riverain) lands of the Ferozepore district, near Mamdot, the Rajah plough is very popular and very effective for eradicating dab grass. But the price is complained about; one zaildar told me that he could buy a pair of the wretched little animals used for ploughing in this circle for Rs. 30 (Rs. 15 each)—the price of the complete plough! Near the same place I was shown a field of sugarcane which had been cultivated by the Rajah plough the produce of which was being sold standing for Rs. 400 an acre, compared with the figure of Rs. 200 an acre, the figure which neighbouring sugarcane fields, which had been cultivated with a country plough, were fetching.

As has been said in previous reports, country blacksmiths have now taken to imitating the Meston plough: one blacksmith in Kotli Nangal, near Gurdaspur, sold 150 shares, and 15 ploughs, of the Meston pattern, which he made himself during the year. The high price of iron is of course preventing progress from being as fast as it would have been otherwise. A small iron foundry at Phagwara (near Jullundur) is trying to manufacture chaff-cutters both power and hand driven, on the English model: a line of action it embarked on without suggestion or hint from any member of the Agricultural Department.

For reapers, the year was, like its predecessor, a bad one. They have risen in price from Rs. 250 to Rs. 350, and this fact, coupled with the comparative cheapness of hand labour in the canal colonies last wheat harvest, (due to the indifferent crop on barani lands) prevented any sale of these articles.

The Professor of Agriculture is working at two types of improved iron ploughs, which will be more suitable to the Province, he thinks, than any of the existing ploughs. He discussed the subject during his recent leave with Messrs. Ransome, Sims and Jefferies at Ipswich and Messrs. Oliver and Co. of South Bend, Indiana, United States of America: both firms are prominent makers of agricultural implements. Correspondence with them is in progress on the subject. The points being kept in mind in designing the new ploughs are, roughly speaking, as follows:—

- (1) Cost must be moderate: if possible not more than Rs. 20.
- (2) There is no need of two handles. Zamindars seldom use more than one handle of the existing Punjab or Rajah ploughs.
- (3) A wheel at the end of the beam is a luxury.
- (4) Elaborate nozzles and hakes and designs for regulating width are unnecessary.
- (5) Draft must be moderate and under $1\frac{1}{2}$ cwts.

The new ploughs will probably be called "Lyallpur" ploughs. The results so far attained with the experimental ploughs are very promising: the Professor of Agriculture says "the Lyallpur plough is a very marked and important advance on anything that has so far been put forward in the Punjab." It is not of course as yet ready to be placed on the market, not yet being indeed entirely out of the experimental stage.

As a result of these experiments, the "Jat" plough has now been finally discarded.

The figures given of implements sold in the year, in the beginning of this paragraph, show that by far the greater part of them are ploughs. Harrows are much fewer in number. The reason for this is not far to seek: the advantages the farmer gains from an improved plough are more than from any one other agricultural implement: and imported harrows cost far more than imported ploughs. Yet it is exceedingly important to introduce among the cultivators improved implements for harrowing, and also to help them to sow their crops in lines. Hence the introduction of simple harrows, drills and hoes—see paragraph 18 of last year's report—made of simple articles as wood and iron, which can be obtained in any village, and which, though infinitely cheaper than the imported article, do work not much inferior to it, has received much attention during the year. At present these simple implements are being made and sold only at the Lyallpur farm, but arrangements are being made, in connection with the measures being taken to increase the area under food grains next winter, to considerably expand the manufacture of bar harrows. Of these implements during the year under report 60 were sold, nearly all to zamindars, at a cost of Rs. 14 each, and 212 drills, costing Rs. 7 each, were also sold. Copies of them, locally manufactured, have already begun to appear in villages.

12. An interesting account of all the work at this farm will be found in Appendix VI: in which Mr. Roberts has also included a short account of the district work in his charge. An additional area of 100 acres has recently been added to the farm: of this 25 acres have been placed at the disposal of the Economic Botanist, and the remainder is under the Professor of Agriculture.

The wheat tests—statements 11 (a) and 11 (b)—are interesting and extremely important. The Economic Botanist's wheat 8 A did very well. I have just asked the Professor of Agriculture to make comparative tests between Punjab 11 and Pusa 12 with varying numbers of waterings: there are, to my mind, distinct indications that Pusa 12 may do well on less water than

Punjab 11 requires. The latter is the wheat we are now pushing in the Colonies, with very considerable success. More detailed mention of this point will be found in paragraph 17. With cotton Mr. Roberts has now initiated, as a result of his tour in America, some very interesting cultural experiments. The varietal experiments with this crop show that 280 F is a very promising American cotton, but it appears to be rather more liable to "jassid" attack than is the well known 4 F.

Of the work being done with agricultural implements at Lyallpur mention has already been made.

13. Full details of this farm are in Appendix VII. It merits perusal. The most important work at the farm is wheat testing: 8 A (one of the Economic Botanist's selections) did best on the well irrigated lands and 17 B on the barani land: 8 A did also very well at Lyallpur and Hansi. The year was not very suitable to the Pusa wheats.

Gordaspur farm.

These very important wheat tests will continue, and should be considerably facilitated by the addition of 50 acres to the farm which will shortly be accomplished.

Three new series of manurial experiments were laid down: they are intended to ascertain the values of phosphatic manures. They must continue for some time. So far no artificial manure has been found to pay.

The wheat outturns on unirrigated lands at the farm were, thanks to the better cultivation they received, very much better than those on the surrounding land which only received ordinary cultivation.

The farm received an increasing number of visitors during the year. It is satisfactory to know that arrangements will soon be completed to accommodate visitors to it.

14. See appendix VIII. The work done does not require much comment. This comparatively new farm is at present greatly handicapped by the uneven quality of the soil, which renders experimental work very difficult. Good cultivation will remedy this to a large extent, but it will take some time. The growth of American cotton in the tract in which this farm lies is handicapped by the local custom of sowing cotton after wheat: in the canal colonies this is very seldom practised. But American cotton has to be sown early, and the wheat is generally not off the ground in time. The Economic Botanist's new wheat 8 A did best in the varietal tests on the whole, though Punjab 11 did exceedingly well in one test. These tests will continue. I have recently again directed the attention of Sardar Darshan Singh, the Deputy Director of Agriculture in charge of the farm, to the supreme importance, at the present stage of his work, to varietal tests both of wheats and cottons. Cultural and manurial experiments must, for the present at any rate, yield in importance to them.

Hansi farm.

15. Interesting experiments were conducted in water saving in the year under report at Gangapur in the Lower Chenab Colony and at Sargodha, in which methods advocated by the Imperial Economic Botanist were tried. These experiments were distinct from those on the same subject which the Professor of Agriculture is trying at Lyallpur. The methods tried in both cases are not of course very different: in this case they consisted of keeping the land in very good cultivation all the preceding summer, so as, *inter alia*, to make as much use as possible of the rainfall, and of frequent harrowing of the wheat, the crop experimented on. At Sargodha farm an area of something under half an acre, received cultivation as just said, had one watering before sowing (on November 5) and none after. It yielded 8 maunds 12 seers ($\approx$ 680 lbs.) of grain per acre, and about three times as much straw. An adjoining plot, of the same size, and under entirely similar methods of cultivation, had one watering—before sowing—on November 5 and one after, on February 16. It yielded 15 maunds 12 seers (1,254 lbs.) of grain per acre, and slightly more straw than the first plot.

Water saving experiments.

Rai Sahib Lala Sewak Ram of Gangapur, Lower Chenab Colony, working on similar lines, got no less than 13 maunds 35 seers of wheat per killa (about 1,042 lbs. per acre), though the crop was not watered after sowing: it received its watering before sowing on October 22, and was sown on November 7. The winter was exceptionally, dry both at Sargodha and Gangapur, no rain falling at either place between the beginning of October and the end of March. The wheat sown in each case was Pusa 12.

The experiments do not of course, pretend to approach finality, and the matter has to be investigated from many aspects before final and definite recommendations on the subject can be made. To take one obvious point, the depths of each watering should be more carefully recorded than was the case here: in them all the waterings given were directed, and reported, to be of the size usual at the time they were given, neither more nor less. But enough has been done to show the enormous importance, and potentialities, of the subject, especially for this province. Paragraph 19 of this report shows that a proposal to initiate water saving experiments on a considerably larger scale than is at present possible is under consideration.

16. I now turn to the progress made during the year in district work, and naturally first deal with cotton, a crop in which the Agricultural Department has been more successful than any other, and which shows surprising developments during the year. I am referring to the largely increased area placed under the now well known American cotton 4 F.

Here are the figures under this crop in the last two years, and the year under report, in acres:—

	1915.	1916.	1917.
Lower Chenab Colony ...	6,000	30,000	120,000
Lower Jhelum Colony ...	1,200	7,000	11,500
Lower Bari Doab Colony ...	500	13,000	80,000
Chunian Colony, Luddan Estate (District Multan) and other areas ...	...	...	3,500
Total ...	7,700	50,000	215,000

This is a conservative preliminary estimate, and the Professor of Agriculture tells me now that he thinks the final area under this crop will prove to be over 225,000 acres. The Canal Department are kindly arranging to have American cotton recorded separately from country cotton, by their village accountants, and correct figures should shortly be available. It will be seen that the area placed under this cotton is now more than 27 times what it was two years ago.

Of this area by far the greater part—say 90 per cent.—is quite pure. The rest is mixed to a greater or less degree with country cotton. We of course spare no endeavour in trying to keep the cotton pure: but, so great is the demand for it, zamindars insist on growing even mixed seed if they cannot get pure seed. We control and provide as much seed as possible: it is reckoned that last spring we provided (having originally bought, or kept control of) 5,000 maunds (= 410,000 lbs.) of 4 F. seed in the Lower Chenab Colony: 6,800 maunds (= 557,000 lbs.) in the Lower Bari Doab Colony: and 1,400 maunds (= 115,000 lbs.) in the Lower Jhelum Colony. At a sowing rate of 4 seers an acre this suffices for the growing of 132,000 acres. We made use, in the spreading of this seed, of many small shop keepers through the colonies, who sold it at a small commission, and gave certificates to the purchasers that the seed given them was that provided by the Agricultural Department. Growers presenting such certificates will find admission to our cotton sales, of which I speak later, easier than will those who cannot produce them.

Of this area of American cotton by far the greater part is sown broadcast, the usual method. But the practice of sowing it in lines (and subsequently inter culturing it) advocated by the Department is slowly but steadily

gaining ground. Exact figures are not available of the amount thus sown, but it is probably about 7,000 or 8,000 acres in all. In the new Lower Bari Doab Colony alone (in which, as the figures already given show, American cotton is making rapid strides in popularity) about 2,800 acres were so sown.

A word now as to the cotton sales organized by the Department. An account of them is given in paragraph 21 of last year's report. This year we held them at six places in the Lower Chenab Colony, but those at Jhang and Tandlianwala had to be abandoned owing to the opposition of the local buyers. At the remaining four we sold 20,586 maunds (=760 tons) of unginned cotton. In the Lower Bari Doab Colony three sales were held, of 22,600 maunds (=837 tons) of cotton: and two in the Lower Jhelum Colony, at which about 8,000 maunds (=296 tons) were so sold. The object of these sales, which the Department merely organizes, and at which, hitherto, any grower could sell his cotton under our auspices, if we passed it as good enough, is to insure the grower getting as nearly as possible a fair price for his cotton: and in this we were generally very successful; particularly in the newly developing Lower Bari Doab Colony: at one of our auctions there the sellers of the purest cotton got Rs. 17 per maund (=82 lbs.) for their cotton, though previous to the sale they had been getting about Rs. 11 or Rs. 12. Difficulties naturally occur during these sales: and I am now considering what changes must be made in the rules governing them, judging by our experience of last years.

The Professor of Agriculture reckons (page xviii of Appendix VI) that an extra profit of 50 lakhs of rupees should accrue to the Punjab zamindar from 4 F cotton this year: this calculation is based on the assumption that the extra premium on it will be Rs. 4 per mensem. Personally I think this figure a trifle high, and prefer to work on a premium of Rs. 3-8-0: which is I consider quite safe. Taking the average outturn as 6 maunds (of unginned cotton) per acre—the same figure as for desi cotton, and the acreage as 215,000, I find that over 45 lakhs of rupees (£300,000) will accrue to Punjab zamindars this winter from 4 F cotton.

The present crop is doing well, though in some places the heavy rain has induced excessive vegetative growth.

Steps are being taken to post this winter at the more important cotton markets of the province Bombay and Lyallpur prices, for general information. This follows a somewhat similar practice in force in Egypt, and should facilitate the grower in his efforts to get a fair price. Government has also agreed, in principle, to rules being laid down for the plans of new ginning factories on sites to be sold by Government, with a view to prevent the mixing of country and American cotton, and seed, in the factory.

Correspondence is still in progress with the British Cotton Growing Association regarding the area of 7,500 acres tentatively reserved for them, in the Lower Bari Doab Colony with the primary object of encouraging the growth of 4 F cotton. The war has thrown many difficulties in the Association's way.

Of country cotton as yet only very small amounts have been put out with zamindars. But, as the reports on the Lyallpur and Hansi farms show, the matter is receiving attention: American cotton has to be sown early, on good land, and the peasant prefers country cotton for his own domestic use. It is thus most improbable—indeed it is practically certain in the south-east of the Province—that American cotton will ever entirely drive out country cotton.

17. I now turn to wheat. In the canal colonies we are pushing Punjab 11, a bearded amber grained wheat: it—
District work: wheat. before ever the Agricultural Department commenced operations—constituted over 70 per cent. of the wheat sown (mixed with other wheats) in the Chenab Colony. It is a heavier yielder than the mixture it supplanted, and this is the principal reason for its popularity: being pure, it also nearly always, fetches a slighter high price in the market.

Last winter we had, it is reckoned, 60,000 acres under Punjab 11 in the Lower Chenab Colony: 22,000 acres in the Lower Jhelum Colony: and 15,000 acres in the Lower Bari Doab Colony. Total 97,000 acres. These figures may be compared with those in paragraph 21 of last year's report.

The Professor of Agriculture at the conclusion of his report (Appendix VI) reckons that three lakhs of rupees additional profit accrued to the zamindar from one lakh of acres under this wheat. His calculation is based on (a) an additional premium of 2 annas per maund (on the total outturn) over the ordinary price of wheat, on an estimated outturn per acre of $13\frac{1}{2}$ maunds: and (b) an increase in yield of at least 20 seers per acre. Personally I think this estimate a little high. Some of the wheat crop last year was, owing to the absence of winter rains, below average, even in the Canal Colonies, especially in the Lower Bari Doab Colony, and I therefore would not place the average yield as high as half a ton as has the Professor of Agriculture. Nor did every zamindar get the premium of two annas a maund: though the great majority did. But that an additional income of at least two lakhs of rupees accrued to the Punjab zamindars who grew this wheat there is no doubt whatever.

For next year, we have expended over a lakh of rupees (out of the wheat profits money of 10·7 lakhs) on the purchase of this wheat for sale for seed this autumn: over 10,000 maunds has been purchased in the Lyallpur district, about the same amount in the Lower Bari Doab Colony, and 13,000 maunds in the Lower Jhelum Colony. These amounts (equal in all to 1,200 tons) suffice for the sowing of 50,000 acres, and in addition very large amounts have been separately stored by large growers, and by some co-operative banks for next season. So next year should see a considerable increase in the area under this wheat.

Considerable difficulty was experienced in purchasing good wheat seed last spring, owing to the storms at harvest time which damaged the crop.

Pusa 12 is exceedingly popular, in the Hoshiarpur, Jullundur, Gurdaspur and Sialkot districts, on well lands. The criticism has been passed on this wheat that it is being encouraged in these districts without sufficient tests having been made as to its suitability for them. Feeling the force of these criticisms, I made a tour last spring through these districts, and was struck by the great and unanimous enthusiasm evinced for Pusa 12 by all the growers of it. They all assured me that they got at least 25 per cent. increased outturn from it, and a premium of at least 2 annas per maund: one grower sold 500 maunds of it to a Lahore contractor, who required it to sell for eating purposes in that city, at a premium of 4 annas per maund over ordinary wheat. In addition to these advantages, of a greater yield, and premium—it is very popular for eating purposes—this wheat has the advantages of being earlier, stronger strawed, and less liable to rust than ordinary wheats. On the other hand, it requires good moisture and does not do so well on barani lands, in winters when the rainfall is deficient as ordinary wheats. It also sheds its grain more than do the latter, but this is a defect common to most beardless wheats.

A certain amount of this wheat is also being grown in the Ferozepore, Karnal, Hissar and Rohtak districts. Everywhere it is exceedingly popular and increasing amounts are being stored for next season by growers: the Panipat co-operative bank is alone storing 350 maunds.

In the circle of the Deputy Director of Agriculture, Gurdaspur, as a whole about 9,000 acres was under this wheat (6,000 acres of this amount was in well lands in the Jullundur district), and about 1,000 acres in the circle of the Deputy Director of Agriculture, Hansi. It is estimated that at least half a lakh of rupees extra profit accrued to the growers of this wheat in these districts more than would have been otherwise the case.

Pusa 4 and Pusa 110 wheats are far from popular, and have very few followers. We do not now push these wheats at all.

On the question as to what wheat will finally prove best suited to the various parts of the Province, a definite answer cannot be given for many years to come: it may well be that we will find wheats better suited to it than even Punjab 11 and Pusa 12. Perhaps it will be the Economic Botanist's new variety 8 A, which, as has already been said, has done very well at our three farms this year.

I have mentioned in this paragraph the "wheat profits" of 10·7 lakhs, which have been given by the Government of India to this Province for agricultural development. In the year under report the only sum disbursed out of this amount was the 1 lakh, already mentioned, on the purchase of Punjab 11 wheat for seed purposes next year. Many proposals for the expenditure of this money are under consideration, but they will find mention in next year's report.

18. Agricultural associations continue to do useful work on the lines indicated in previous reports: an association has now been formed in the Lower Bari Doab Colony. District work : general. Demonstrations of improved implements and cultural methods were given at some 20 fairs. More useful than these were similar demonstrations given by our men in ordinary zamindars' land with their own bullocks, to which more attention is being yearly devoted.

The special farms in the Lower Bari Doab Colony, belonging to Mr. Conville, S. Jogendra Singh, Colonel Cole and Mr. Vanrenen, mentioned in paragraph 15 of last year's report, all continue to do well.

I note only one instance of many I might give of the increasing influence of the department. Village Chak No. 267 of the Rakh Branch, Chenab Colony, had abandoned cotton for sugarcane: to which its land was not very suitable. One Ghulam Muhammad of the village came to the Lyallpur farm in March 1916, and was impressed with what he heard and seen regarding American cotton. He sowed one acre of this in lines, and inter cultured it, as advised, with a Gujrat hoe. The result was that he got a yield of 1,300 lbs. per acre. Many are now growing American cotton in the village, which has now bought 4 drills, eight chaff cutters, a Lyallpur hoe and a horse hoe. It is also using a bar harrow, and imitations of it have appeared in the village.

The other minor lines of activity mentioned in paragraph 22 of last year's report all continue. Ground nuts may eventually do well in light sandy lands: experience so far with them is hopeful. They are unsuitable to the Canal Colonies. Long eared Australian bajra is becoming very popular. Some selected sugarcane is now being given out on a small scale in the neighbourhood of Gurdaspnr, and is promising. Hoshiarpur rice is being introduced, on a small scale, into Ferozepore. The Deputy Director, Hansi, has shown the zamindars of Panipat (district Karnal) that the high seed rate for wheat they commonly adopt— $1\frac{1}{2}$ maunds (123 lbs.) an acre—is too high, and that they can get better results with a rate of half that figure.

Much of the work at the farms is compliance with ordinary requests for seed. Thus the Gurdaspur farm provided (or arranged to provide) last year, in addition to large quantities of maize, jawar, cotton and rice seed, 500 lbs. of san hemp seed for green manuring (this practice is gaining in popularity, but very slowly), and 3,200 lbs. of Australian bajra seed. We received also last year demands for nearly 250,000 lbs. of castor cake for manure for potatoes, but were unable to comply with the greater part of it. The Lahore Central Jail is the only place in the province that now crushes castor seed, and importation from outside is very expensive. Some district boards are now beginning to ask me to arrange to buy good seed for them, especially wheat. Thus for the Sialkot board we have arranged for the purchase of 500 maunds of wheat seed. The boards of course finance these operations completely. In Shakargarh Tahsil the co-operative banks are considering the institution of a "co-operative sale of grain society." Connected with it it will probably be found advisable to erect a seed godown, to take at least 500 maunds of seed. Proposals to erect one such, in that tahsil, and another somewhere in the Hoshiarpur District, at the cost of Government, are under consideration. In the sub-montane districts, with their heavy rainfall and bad communications, peasants often find it difficult to get good seed at sowing time.

Among the recent requests I have received for seed is one for two tons of seed onions for Mesopotamia.

A few words may be said on jute. Quite a good crop was grown at Lyallpur last autumn. But only part of it was retted as it took a very long

time to ret. Mr. Finlow, the Fibre Expert to the Government of Bengal, who saw the crop twice, says that there is at present no prospect for jute in the Punjab on account of the high price of labour, shortage of water for retting, and the comparatively long time it takes to ret jute in this Province. The only hope rests with mechanical extraction of the fibre, a problem on which Mr. Finlow is working, but has not yet solved.

During the year the small Basal demonstration farm—paragraph 14 of last year's report—was closed. It was impossible to supervise it properly, so remote was its situation from any of our other present activities. The Sialkot and Gujrat district board farms are working satisfactorily. Proposals in connection with other similar farms have been received from Amritsar—a small farm is already in existence at Beas in this district—Hoshiarpur, Ludhiana, Ambala and Rohtak, and are under consideration. These farms are mainly demonstration: they are only experimental to the extent required by the special circumstances of the district in which they are situated. They are run entirely by the Agricultural Department, though financed by the district board concerned.

19. Of the very large increase in the area under American cotton and the expanding areas in wheats recommended by the Department I have already spoken. The former is by far the most striking achievement of the provincial Agricultural Department since its inception. For the rest, the year has been one of steady progress in all lines. The Agricultural College has become popular with all classes, and is doing admirable work. At a recent Conference of Co-operative Societies in Gurdaspur it was decided to start six demonstration plots, in which the crops recommended by the Department would be cultivated in the manner recommended by it. The plots will be small—2 to 3 acres each—and will for the present be in charge of our men: the co-operative societies will however provide the land and finance them. Each union in Gurdaspur is also giving a scholarship for the vernacular class at Lyallpur, and so are some banks in other districts. A proposal to initiate experiments in irrigation problems on a much larger scale than has hitherto been possible is under consideration: the Irrigation Department has been good enough to place an area of some 300 acres at our disposal for the purpose. Proposals for a rice farm in the Upper Chenab Colony will shortly be put forward. It is a crop which we have not yet touched, but which is grown to a considerable extent in the Kangra and some of the central sub montane districts. I have already selected a site for it. Proposals as to the head quarters of the Deputy Director of Agriculture to be stationed in the North Punjab, have recently been submitted.

20. All the officers of the Department have worked hard and well during the year. My acknowledgments are particularly due to Mr. Roberts, who is doing excellent work for Government, both as Principal of the College, and as Professor of Agriculture.

Many district officers are most cordially co-operating with us. In this connection special mention should be made of Mr. Kitchen Deputy Commissioner of Lyallpur, Mr. Joseph, late Colonization Officer, Montgomery, and Mr. Thomson, his successor. The officers of the Irrigation Department in the Lower Bari Doab Colony, particularly Mr. Jesson, have helped us greatly in spreading American cotton: every Zilladar there had a certain amount of American cotton seed given him for sale in his neighbourhood last spring. Mr. Calvert, Registrar, Co-operative Societies, and his Assistants, are always ready to co-operate in any way they can.

The subordinate staff have, as last year, all worked hard. In this connection I must also mention my own office, and the College office at Lyallpur, both of which continue to bear bravely an ever increasing load of work.

C. A. H. TOWNSEND,

Director of Agriculture and Industries, Punjab.

September 1917.

APPENDICES.

APPENDIX I.

Report of the Principal, Punjab Agricultural College.

THIS is the first quinquennial report of the Punjab Agricultural College, which was opened in 1909. It deals with the period from 1911-12 to 1916-17.

Since its institution the college has passed through many vicissitudes. It started with a three-year course, which after a few years' experience proved unsatisfactory. The number of students seeking admission to the college began to decline, until a crisis was reached in 1913, when no new class could be formed. As the result of this failure, and in pursuance of the recommendation of the Board of Agriculture held at Coimbatore in December 1913, a modified course extending over a period of four years, and divided into two parts of two years each, was adopted. This course has been in force since 1914 and met with some measure of success. The first part consists of simple practical instruction in agriculture and elementary courses in scientific subjects, and the second part gives a systematic course in sciences applied to Agriculture. At the end of the first part a Leaving Certificate is granted to successful students on the result of an examination, which qualifies for admission into the subordinate ranks of the Agricultural Department, and for such posts as estate managers etc.

The second part leads to the Diploma of Licentiate in Agriculture, given to passed students on the results of an examination.

The success of this course, compared at any rate with its predecessor, I attribute to the following causes :—

- (a) The prospects of upper subordinates in the Agricultural Department, which was the main avenue for employment of college diplomates and leaving certificate passed men, were substantially improved.
- (b) The course qualifying for Government service was reduced from three to two years.
- (c) A number of posts in the Revenue Branch of the Irrigation Department was thrown open to the passed students of the college and a demand for employment of these men by private individuals (estate holders) also sprang up as a result of the activities of the Agricultural Department.

This course, however, was also in reality radically unsound. Experience has shown that it is unsuitable for scientific education; for students after going through the practical course of the first part have shown their inability to assimilate higher scientific training. They lack in exactitude and facility of expression, without which higher scientific education can hardly be of any practical value. These defects were considered at a conference for all India held at Pusa in February 1916, and a resolution advising the association of agricultural education with university activities was passed. Following this advice and the opinion of the educationalists in the province, we have now decided upon a scheme of affiliation with the Punjab University, the institution of a Degree of B. Sc. (Agriculture), and an intermediate examination at the end of the first two years. The proposal for affiliation has been approved by the Senate, and the new Degree Course is being taught in the new session just started. There was some danger that the modification of the course, whereby the attainment of a degree at the end of four years becomes the main line of effort for students, in place of a certificate at the end of two years and a diploma after four years, would be unpopular.

Provision has been made for a certificate to be given at the end of two years for those not wishing to take a degree.

We have received over 200 applications for admission as against 138 last year, and 33 in the year ending the last quinquennium (1910-11). In reviewing the last quinquennial report of the Education Department, His Honour the Lieutenant-Governor expressed a hope as to the "ultimate success" of the institution and its becoming "a most valuable factor in the gradual application of science and the results of experiments to the development of the agricultural resources of the province." That hope seems to be giving promise of fulfilment. The results so far achieved are encouraging, and the activities of the department will, it is hoped, continue to increase and expand as time goes on.

In February last I took over charge of Principal's office from Mr. Barnes, who was transferred to Pusa as Imperial Agricultural Chemist. His death at Pusa on June 2nd was deeply regretted by the college staff and students. He had controlled this institution for about 8½ years as Principal, and, has left a brilliant record of work after him. The college owes a great deal to his energy and great ability.

New Session.—At the opening of the new session on 20th July 1916, the number of students on the rolls of the college was as follows :—

First year	...	...	...	...	...	38
Second year	...	...	...	...	...	20
Third year	...	...	...	...	...	7
Fourth year	...	...	...	...	...	<i>Nil.</i>

Against the above the number on rolls in 1911-12 was as follows :—

First year	...	...	...	...	...	20
Second year	...	...	...	...	...	16
Third year	...	...	...	...	...	10

The number of withdrawals during the year under report was 3, so that we had 62 students at the end of the session.

Class for Revenue and Irrigation Officers.—The number of Revenue and Irrigation Officers who attended the course, lasting for one month, in Indian Rural Economy, held in March last, was as detailed below :—

1. Extra Assistant Commissioners	...	...	...	6
2. Assistant Registrar, Co-operative Societies	...	...	...	1
3. Inspectors and Sub-Inspectors of Co-operative Societies	...	...	...	3
4. Zilladars of Canal Department	...	...	...	10

There was no Assistant Commissioner or Assistant Engineer this year.

Vernacular Course.—Total number of applications for admission to this class was 101, as against 51 last year : 38 were admitted, of whom 8 left without completing the course. Of the 30 who passed through the class 27 were agriculturist and 3 non-agriculturist.

The class continues to maintain its progress and is increasing in popularity. I think the time has now come to extend the scope of its usefulness by starting similar classes at Gurdaspur and at other convenient centres. At Lyallpur we cannot provide training for more than a class of 30 to 35.

It is probable that the character and scope of the Vernacular Class will be modified to meet the needs of Rural Education teachers. The Lyallpur Institute could by this means make its influence more felt in the general educational system of the province, and its influence would spread more rapidly than through the present Vernacular Class, good as the latter is in its way.

For the next class which commences in October, we have so far received 40 applications.

Caste of Students (College Courses).—The classification of students according to their religion is as follows :—

			1916-17.	1911-12.
Europeans	...	...	<i>Nil.</i>	...
Indian Christians	...	...	...	...
Muhammadans	...	...	23	16
Hindus { Brahman	...	...	1	3
{ Non-Brahman	...	...	19	20
Sikhs	...	...	19	11
			—	—
Total	...	...	62	50
			—	—

Examinations.—The following table gives the details of examinations held and number of students at each examination. Figures for 1911-12 are also given :—

Class.		Number of students examined.		Number of students passed.	
1911-12.	1916-17.	1911-12.	1916-17.	1911-12.	1916-17.
First year	First year	23	35	16	32
Second year	Second year	16	20	13	20
(Leaving Certificate Examination.)					
Third year	Third year	10	7	8	6
	Fourth year	...	...	...	...

Mr. J. B. Knight, Professor of Agriculture, Agricultural College, Poona, conducted the examination in Agriculture as external examiner at the Leaving Certificate Examination

and Mr. G. S. Chowla, Professor of Mathematics, Government College, officiated as external examiner in Mathematics for the third year—Diploma Class. The former in his report has expressed a very high opinion of the students' progress and the standard reached by them in Agriculture. The latter on the other hand reports on the unsuitability of the existing syllabus in Mathematics, and recommends its simplification. The present curriculum being under revision as a result of affiliation to the Punjab University, it is not necessary to dwell upon this point at any length here.

Scholarships.—Owing to two nominees having failed to join, their scholarships remained vacant. These, together with one more surrendered by a student of the first year, have been awarded on the result of the Sessional Examinations.

The number of scholarship holders in each class as compared with that in 1911-12 is as follows:—

	1911-12.	1916-17.
First year	10	8
Second year	10	10
Third year	10	5
Fourth year	Nil.	Nil.

The Entrance Scholarship Examination for 1917-18 was held on May 14th, 1917: 83 appeared, of whom 10 have been awarded Government scholarships.

Applications for Admission.—The number of applications for admission to the Degree Course commencing in July 1917 from each provincial division, Native States and other provinces is given.

Name of divisions.	Nominations for Entrance Scholarship Examination.	Applications for admission as ordinary students.	Total.
Ambala	8	6	14
Jullundur	24	25	49
Lahore	17	29	46
Multan	21	19	40
Rawalpindi	13	12	25
North West Frontier Provinces	...	1	1
Native States	...	17	17
Other provinces	...	10	10
Total	83	119	202

Of the above I have in all selected 40 candidates for admission.

Scholarships Awarded by District Boards and private donors.—Information under this head is given below:—

DIPLOMA COURSE.

District.	Name of donor.	Value of scholarship per month.
		Rs.
Dera Ghazi Khan	District Board	15
Jhang	Ditto	6
Jullundur	Ditto	15
Ferozepore	Ditto	10
Lahore	Rai Bahadur Mohan Lal	12
North-West Frontier Provinces	...	Two scholarship of Rs. 40 each.
		Rs.
Patiala State	...	20
Jind State	...	35

VERNACULAR CLASS.

<i>Name of donor.</i>	<i>Number of scholarship.</i>	<i>Total value of of scholarship.</i>
		Rs.
District Board, Mianwali ...	2	100
Ditto Jhelum ...	2	100
Ditto Karnal ...	2	84
Ditto Lahore ...	2	100
Ditto Sialkot ...	1	30
Ditto Gujrat ...	1	50
Ditto Shahpur ...	1	50
Ditto Ludhiana ...	1	50
Ditto Lyallpur ...	4	200
Ditto Rohtak ...	1	49
Khan Bahadur Riaz Hussain, Multan ...	1	50
District Board, Hoshiarpur ...	2	100
District Board, Gurdaspur ...	1	50

My thanks, are due to all these donors for their generous grants. It will be seen from the above list that, excepting Karnal and Sialkot, all the district boards accepted my predecessor's proposal regarding the fixing of the grant at Rs. 50 (see remarks in last year's report).

Government Research Scholarship.—As in last year no suitable candidate was forthcoming this year.

Hostel, Clubs, etc.—There is nothing of importance to report under this head. A silver cup was presented by the late Mr. Barnes for cricket, and another was presented by the members of the college office establishment in honour of Mr. Barnes at the time of his transfer to Pusa.

The health of the students has continued to be satisfactory.

Buildings.—The work of extension of the college hostel is in progress. No other work of importance has been carried out during the year under report.

Library.—The work of re-organisation reported last year is in progress.

Staff.—Some important changes took place. To one, *viz.*, that of Principal's office, I have already referred in my opening remarks. The other relates to the Agricultural Chemist's office which has been filled by Mr. B. H. Wilsden who is a member of the Indian Educational Service and has come to us from the Government College, Lahore. Mr. Faulkner, Deputy Director of Agriculture, who is now stationed at Lyallpur devotes part of his time to college work.

College Office.—Two new clerks were added to the office establishment this year. Office is, however, still understaffed and owing to the expansion of Department's work in every direction the load of work on the clerical side has also considerably increased.

Expenditure.—The expenditure on the college during the past year has been Rs. 97,411 as against Rs. 92,517 in 1911-12. The income and expenditure of the past five years is as follows:—

	<i>Income.</i>	<i>Expenditure.</i>
	Rs.	Rs.
1912-13 ...	11,739	98,277
1913-14 ...	7,553	1,10,593
1914-15 ...	9,088	1,55,955
1915-16 ...	16,691	1,07,657
1916-17 ...	18,547	97,411

APPENDIX II.

Report of the Agricultural Chemist.

Staff.—Mr. Barnes was transferred from Lyallpur to Pusa on 19th February 1917 afternoon, and Bhai Jagat Singh, M.Sc., officiated till March 17th, when Mr. B. H. Wilsdon, B.A., I.E.S., took over charge. The death of Mr. Barnes occurred at Pusa on 2nd June 1917, from enteric fever. The Department of Agriculture has lost in him a worker of great imagination and personality.

Research.—Several investigations were brought to completion before the transfer of Mr. Barnes—

- (a) A Bulletin on "sugar and sugarcane in the Gurdaspur District", comprising the results of the last five years' work is in the Press.
- (b) A paper on "Oxidases of the Sugarcane" is ready for publication.
- (c) The results of investigation on the "Tube well waters of the Punjab" are summarised in a paper read at the Indian Science Congress (1917) and published in the *Agricultural Journal* (Indian Science Congress Number of 1917). Supplementary results to the above were prepared for publication.
- (d) A note on nitrogen fixation in Punjab soils is ready for publication. The results, which must be regarded as preliminary to more extensive work, indicate that large quantities of nitrogen derived from the atmosphere are fixed in the soil during the period of fallow from May to October.
- (e) A paper on the biological methods which have been used in investigating the causes of infertility of barren soils is ready for publication. This work arose during the investigation of the so-called Bara and Bari lands of the Montgomery Colony. Some 24 analyses of typical soils in the area were made and laboratory experiments tend to show that methods of washing the soil similar to those used successfully with the 'Reh' soils of Narwala, will prove effective in dealing with these soils.

A comprehensive scheme for the reclamation of Bara land at Montgomery was drawn up by Mr. Barnes and his proposals after discussion at the meeting are before the Government.

Work in progress.—(a) Measurements of the percolation of water through the canal and farm drain gauges are being continued as is also work initiated by Mr. Barnes on the gaseous exchanges occurring between the atmosphere and soil.

(b) Work directed towards the perfection of a method for the laboratory determination of transmission constants of soils has been put in hand.

(c) The general question of the flow of viscous liquids in porous media is being attacked.

(d) A series of experiments on the movement of moisture in the soil have been initiated.

(e) A survey of Punjab oilseeds has been put in hand. Since April toria has been examined.

General.—Sixty-nine samples of soils, water, manures and food stuff have been analysed during the year for departmental and provincial purposes.

Experiments on the causes of the occurrence of efflorescence on brick work have been taken up at the request of the Public Works Department. The matter will shortly be ready for report.

B. H. WILSDON,

Agricultural Chemist, Punjab, Lyallpur.

APPENDIX III.

Report of the Economic Botanist, Punjab.

Cottons.—Then acres of land were available for cotton experiments. Rains in early summer increased vegetative growth but delayed flowering about two weeks. First pickings were also late but by the end of the season outturns of kapas were quite good.

Acclimatised American cottons.—Lints from American selections were kindly valued by Messrs. Tata Sons & Co., Spinners, Bombay. They valued six of these selections as equal to middling American and one as rather better. Practically all others were valued as better than Sindh American.

The following table shows outturns per acre, Messrs. Tata's valuations and the gross incomes got from eight acclimatised American selections :—

Serial No.	Number of cotton.	AREA OF PLOT.		OUTTURNS OF KAPAS (UNGINNED COTTON) PER ACRE.		Kan (per cent. of fibre to unginne cotton).	Spinning counts.	Total yield of fibre from one acre.		Price of lint per candy of 784 lbs.	Value of lint per acre from valuation given by Tata Sons & Co.		Value of seed got from one acre at Rs. 2-12-0 per maund.		Gross income per acre.		REMARKS.		
		Acres.		Maunds.	Seers.			Lbs.	Rs.		Rs.	A.	P.	Rs.	A.	P.		Rs.	A.	P.
1	161 A F	$\frac{1}{18}$		14	27	31	30 to 40	373	530	275	15	0	27	2	0	303	1	0	Grown on dry hard land.
2	280 F	$\frac{1}{8}$		8	18	28	50	194	650	160	12	0	16	4	0	177	0	0	Grown on very poor land.
3	231 F	$\frac{1}{8}$		10	34	29	44	258	630	207	5	0	21	2	9	228	7	9	Grown on rather poor land.
4	282 F	$\frac{1}{8}$		10	21	29	50	250	650	207	4	3	20	7	9	227	12	0	Ditto.
5	285 F	$\frac{1}{18}$		18	36	32	50	496	650	411	1	0	35	6	0	446	7	0	Grown on heavy loam.
6	286 F	$\frac{1}{8}$		18	15	29	50	318	665	269	11	9	25	13	9	295	9	6	Grown on fair land.
7	287 F	$\frac{1}{8}$		14	19	31	48	367	650	304	4	3	26	8	0	330	12	3	Ditto.
8	288 F	$\frac{1}{8}$		11	36	28-5	48	278	640	226	15	0	23	6	0	250	5	0	Grown on rather poor land.

Above are actual data got, but in absence of facilities to interstrip varieties with a standard variety, the gross incomes noted are not as reliable indications of probable values of these cottons to zamindars as they should be. They are the best indications I have however.

Many other samples were valued between Rs. 570 and Rs. 630. Messrs. Tata report that on the date of valuation Sindh American was selling at Rs. 530; American middling spot Liverpool 19d. per lb; F. Navsari at Rs. 600 and Cambodia at Rs. 550 per candy.

Experience in the past year again emphasises the fact that the quality of the lint of these cottons is very greatly affected when grown here on soils of markedly different physical characters. This is obviously a very important factor in the growing of long stapled cottons in the Punjab; and as the growing of these within the British Empire is a problem of national importance, I hope that staff may be made available early to enable us to look thoroughly into this point and others.

From the results on the small areas available all the cottons quoted in the table above and several others seem better than 4 F.

It seems necessary to point out that all rough leaved American cottons grown in the Punjab are not 4 F. Among my selections it was neither that with the highest "Kan" nor that with the longest lint. Not one or two, but many characters must be carefully investigated in successful selection work, and 4 F is a selection, the economic value of the sum of the characters of which indicated that it would yield a much larger profit per acre to growers than the American cottons which people were then attempting to grow.

Desi cottons.—Quite a number of very promising desi selections are on hand. See also reports of Professor of Agriculture and Deputy Directors of Agriculture for notes regarding those already handed over to them.

Cotton surveys.—Cottons in the districts of Shahpur and Sialkot were surveyed.

Wheats.—Twenty acres of land were under wheats. The 25 original Punjab types, 36 later classified types and about 150 crosses were grown. Types 8A, 8B, 9C, XVIIIB, XXC and crosses No. 2 and 3 were tested on quarter acre plots in duplicate against Pusa 12 and Punjab 11. Results were most promising. As usual, 8A stands at the top. A shower of hail at Lyallpur on 10th April did considerable damage to wheats. 8B and Pusa 12, which, ripening early, happened to be about ripe at that time were much more damaged than others. Other types had to be grown on very small areas. In the year under report, the Deputy Director of Agriculture, Gurdaspur, tested the cropping powers etc. of a few of my wheats in his lands by interstripping them with other varieties being tried in his circle. A test in which 8A, 8B, Punjab 11 and Punjab 17 were interstripped with Pusa 12 as a standard, was arranged in a chahi (well irrigated) field on the Gurdaspur farm. Results were as follows. The plots of land were all the same size, slightly over a quarter of an acre each:—

Type No.	Outturn of grain per acre.	
	Mds.	Srs.
8A	32	7
Pusa 12	26	7
8B	28	9
Pusa 12	23	3
Punjab 17	33	3
Pusa 12	29	22
Punjab 11	23	39
Pusa 12	23	22
8A	32	33
Pusa 12	24	39
8B	25	22
Pusa 12	24	24
Punjab 17	26	37
Pusa 12	25	18
Punjab 11	19	29
Pusa 12	20	28

One maund = 40 seers = 82 lbs.

The plots were arranged in the above order. Apparently 8A has given the best results. The only higher outturn than 8A is 33 maunds and 3 seers from one plot of Punjab 17 but as Pusa 12 just below it gives 29 maunds and 22 seers per acre, instead of its 24 maunds and 39 seers below where 8A gives 32 maunds and 39 seers, I think that land on which Punjab 17 gave its 33 maunds and 3 seers, is better than that of either of the plots of 8A. This is borne out by the fact that the plot of Punjab 17 noted further down the list, can only yield 26 maunds and 37 seers per acre on lands which apparently from the standard above and below it could have yielded about 25 maunds of Pusa 12. In another test in which 8A, 8B, 17B, 20C and Pusa 12 were interstripped with Punjab 14 on barani land on the same farm, 17 B gave the highest outturn, but the variations in yield given by the standard variety clearly indicate that the land is too irregular in quality to enable safe conclusions to be drawn. The past year is the first of such tests at Gurdaspur and I hope that they will be conducted annually. If so, the department will soon be in a strong position regarding which wheats to recommend and my work would be facilitated. At the Hansi Farm types 8A, 8B, XVIIIB and XXC have done extremely well, but the lands appear to be so irregular that until the varieties are arranged in long narrow strips with a standard variety at very close intervals, no reliable comparative results will be got. For tests of 8A, 8B against Punjab 11 on the Agricultural Farm, Lyallpur, see Professor of Agriculture's report. 8B probably suffered a good deal by the untimely hail-storm.

Preliminary milling and baking tests with 8A, 8B, 9C and 17B gave most promising results. Mr. Wilsdon, Agricultural Chemist, Punjab, very kindly analysed a number of wheat samples for me. The results are given below :—

Register No.	Number of type.	Moisture per cent. (24 hours in steam oven).	Nitrogen per cent.	Starch per cent.	Indigestible fibre per cent.	Ash per cent.	Soluble carbohydrates (as glucose) per cent.
61	VIII-A ...	8.36	2.50	66.0	2.09	1.74	3.38
62	VIII-B ...	8.38	2.78	67.1	2.55	1.65	3.05
63	XVII-B ...	8.51	2.35	68.0	1.93	1.52	3.36
64	IX-C ...	8.80	2.15	68.5	2.14	1.46	3.55
65	XVII ...	8.07	2.23	70.1	2.13	1.54	4.05
66	XI ...	8.16	1.86	71.6	2.56	1.47	3.70
67	Cross 3 ...	8.88	1.76	72.2	2.00	1.70	3.38
68	Cross 2 ...	8.48	1.83	70.5	2.39	1.63	3.90
69	XX-C ...	8.25	1.97	68.2	2.25	1.54	4.73
70	Cross 45 ...	9.24	1.73	70.8	2.11	1.57	4.11
71	Pusa 12 ...	8.33	2.08	68.5	2.21	1.72	4.66

Barley's and gram.—Want of staff has delayed most promising work.

Scotch potatoes.—Potatoes being introduced into Simla hills yielded Rs. 180 approximately more per acre than the local potatoes grown interstripped with them. The demand for seeds is far greater than the supply.

Date palms.—See book now due from press.

Ear-cockle in wheat.—Fields showed up to over 50 per cent. damage. Experiments indicate that remedy is easy. Matter being seen to as far as staff permits.

D. MILNE,
Economic Botanist, Punjab.

APPENDIX IV,

Report of the Assistant Professor of Entomology.

I.—Pests of cotton.—(1) Cotton bollworm (*Earias insulana*, Bois and *E. fabia stoll*), and its parasite (*Rhogas* sp.).

Last season the parasite was kept at 10 to 15 per cent strength in the parasite breeding plot at Hansi and by the beginning of August it was established in cotton plots in five other important cotton districts. From these, over one thousand parasite boxes were distributed during August and September throughout the cotton growing tracts. The effect was well marked; all tendency towards the increase of bollworm attack was checked and the damage which had gone up to 20 per cent in July in certain tracts was reduced to 4 or 5 per cent. in August by the help of the parasite boxes.

This season the parasite has been found at Hansi in March; it is being successfully bred and will be ready for distribution in large numbers by the middle of July.

(2) *Mytillocerus blandus*, Fst.—This insect occurred for the first time in April last as a very serious pest on young germinating cottons. Its ravages extended over a large tract in the newly opened area round Khanewal. After investigation the sowing of maize as a trap crop with cotton was recommended. The pest confined itself almost entirely to maize; the cotton was thus saved and grew successfully.

Practical control measures have been tried against the dusky cotton bug (*Orycterus latus*, Kirby) and the red cotton Bug (*Dysdercus cingulatus*, F.). A small note about the important insect pests of cotton in the Punjab has been published both in English and Urdu giving a few simple methods of controlling them.

II.—Mango loppers (*Idiocerus* spp.).—The life history and habits of this serious pest of mango blossoms have been studied. Control experiments carried out at Hoshiarpur show that five sprayings with Fish Oil Resin Soap (strength 1 lb. in 15 gallons of water) from the beginning of February till the end of March are enough to ensure the successful setting of the flowers into fruits. These five sprayings cost Rs. 0-6-9 per tree. Spraying, however, is practicable only in the case of valuable grafted trees. In the case of the country mango spraying is far too costly and difficult to be recommended. Thinning out of mango groves, and the breaking up of the surface of the land around the roots of the remainder, so as to cause stronger and healthier trees, appears the most hopeful line of action.

A preliminary investigation of *Idiocerus* spp. and *Monophlebicus stebbingi*, Gr., which attack mango trees in the Shalamar Gardens, Lahore, has been made.

III.—*Rhynchophorus ferrugineus*, Fb.—During last September–October the Arabian date plantations at Muzaffargarh were severely attacked by the 'Palm Weevil'. The attack was reported in November when it had advanced considerably.

The following measures were tried :—

- (i) *Scrapping.*—Grubs which were near the surface were removed by this method. Two hundred and twenty-eight grubs were extracted from 64 trees in 11 days.
- (ii) *Injections of carbon bisulphide, Lead Arsenate and Crude Oil Emulsion etc.*—They were not effective, for they did not reach the grubs which had gone deep into the tissues.
- (iii) *Erection of mud enclosures round the affected trunks.*—These mud enclosures were constantly kept filled with water which gradually soaked through the tunnels, and when it got at the grubs they wriggled out of the holes, fell in the water and got drowned. Four hundred and thirteen grubs were extracted by 37 days' treatment.

As a result of these operations all the attacked plants have been saved except two.

IV.—*Euphalerus citri*—This Psylla disease is extensively attacking the citrus gardens at Sargodha. Preliminary investigations have been completed regarding this and the trial sprayings with Crude Oil Emulsion ($\frac{1}{2}$ pint in 4 gallons of water) have proved effective in dealing with this pest. Arrangements have been completed with the owners of gardens for spraying on extensive scale.

V.—*Euproctis flava*, F.—This moth has been bred from castor, cotton, rose, peaches, pomegranates and mangoes. During last May and June the caterpillars attacked grapes in large numbers. The simple treatment of ejecting water through a powerful sprayer on caterpillars clustered in the bunches proved effective. By the force of the water the caterpillars were dislodged and fell on the ground.

VI.—The routine work of controlling regular insect pests on the farms etc., has been in hand.

VII.—Sericulture.—Last season 700 ozs. of French silkworm seed was distributed. Sheikh Ghulam Sadiq distributed 423 ozs. in Gurdaspur District; Messrs. Kotu Mal and Ram Lal also gave 150 ozs. in Gurdaspur District while we distributed 122 ozs. of seed in Sialkot, Ambala and Hoshiarpur Districts.

The rearing was done by the village boys in 37 Primary Schools: $\frac{1}{4}$ oz. of seed was given to each school.

The result of the rearings from 578 ozs. of seed alone are available. The total produce of dry cocoons was 95 maunds and 10 seers for which Rs. 9,074-9-0 were realised in all.

The competition for buying the produce of our rearers was high. We obtained Rs. 138 and Rs. 130 per maund of dry cocoons.

The annual exhibition of silk cocoons was held at Gurdaspur on the 25th and 26th of May 1917. Rupees 321 were given in small prizes to successful competitors.

MADAN MOHAN LAL,

Asstt. Professor of Entomology, Punjab, Lyallpur.

APPENDIX V.

Report of the Agricultural Engineer,

Introductory.—The high prices prevailing throughout the year, combined with the difficulty in obtaining materials, have seriously handicapped the outturn of work, but it is satisfactory to record that considerable progress has been made over the work of the previous year.

Well boring.—The object of this work is to increase the supply of water in ordinary wells, and for this purpose a boring establishment consisting of 3 supervisors, 20 borers and 20 mates is maintained. During the year a total of 538 wells were bored, this being an increase of 192 over the previous year's work. An increase of water was obtained in 373 of the wells bored, representing a percentage of success 69½ against 68½ in the previous year.

As previously reported, the majority of failures are due to the well owners being unprepared to pay the cost of completing the boring, and frequently bores are abandoned for this reason when local conditions indicate that success is near.

The use of strainers, which were introduced last year, where sub-soil conditions proved unsuitable for the plain pipe method has been considerably extended, and during the current year strainers have been employed in 147 wells, all of which are successful, the increase of water averaging four times the original supply of the well. The average cost of each of this class of bore did not exceed Rs. 100. Cost price is charged for strainers: and the fact that these are now nearly double their price of a year ago amply illustrates the willingness of the cultivator to invest his money in an irrigation water-supply.

Tube wells.—Large diameter bores from which water is pumped by mechanical power are included under this head. During the year under report six schemes of this nature have been completed or three more than in the last year. The aggregate cost amounted to Rs. 33,000. Two only of these schemes have been put down by private enterprise, the remaining four being for public bodies. There are many enquiries for this class of work and during the year 70 out of 80 of these had to be estimated for in very considerable detail. At the time of writing four schemes of this type are in progress, but work is considerably delayed on account of difficulty in obtaining materials.

Boring plant.—No heavy power boring plant has yet been obtained owing to financial stringency and therefore the places marked out for artesian water-supplies have not yet been exploited.

A light power boring plant has however been ordered and is expected to arrive in the autumn of 1917. This will facilitate work to a considerable extent and render the boring work largely independent of hand labour which owing to harvesting operations, stops this class of work for a considerable period of the year.

Other works.—During the year two flexible and cheap harrows were designed and made up for experimental purposes. Owing to faulty design these did not fulfil requirements, but the possibility of removing the defects while still retaining the essential qualities aimed at, is hopeful, and investigations are being continued. The type grain godown designed for and erected by Mr. Conville of Convillpore in Montgomery District has been completed and in use for several months; the capacity of the godown amounts to 3,750 maunds; it is of the "floor level, damp proof, and ventilated type."

A reinforced concrete elevated grain bin of 500 maunds capacity has been designed and constructed at Lyallpur. This bin permits of the grain being run direct into the bag, and the bin being entirely emptied by gravity. From an engineering point of view the bin is of interest on account of its novel design, and from the fact that it is constructed from cement made entirely in India.

Reinforced concrete water tanks for the circulation of water in oil-power pumping plants have been constructed. This was necessitated owing to the difficulty in obtaining steel tanks, the price of the reinforced concrete tanks being less than half the cost of steel tanks and the life considerably greater.

The high price of metals has necessitated the making of many articles in other materials. Small size grain bins for storing seed usually made in metal have been made from reinforced concrete at two-thirds of the cost of the metal equivalent. Sluices for irrigation channels have similarly been designed and made at a reduced cost in concrete.

A new type of food valve for pumps has been designed and made up: the use of this valve will save several hundred rupees per tube well installation.

A well pump for irrigation purposes by bullock power has also been designed and together with several other designs connected with water lifts awaits the erection of a workshop for construction and trial.

Progress on a large scale can undoubtedly be made with lift irrigation, but until the present financial stringency is lessened, problems of this nature must necessarily be shelved.

The continuing rise in prices and increasing difficulty in obtaining plant and materials, while it has handicapped the work of the past year, is undoubtedly still likely to further handicap the work of the coming year also.

T. A. MILLER BROWNLIE,

Agricultural Engineer to Government, Punjab.

August 1917.

Appendix A.

WELL BORING.

Serial No.	Name of district.	WELLS.		REMARKS.
		Number of bores.	Successful.	
1	Gurgaon ...	86	76	Rewari Circle— Percentage of success 82.1 per cent.
2	Karnal ...	28	15	
3	Ambala ...	8	1	
		112	92	
4	Ludhiana ...	63	34	Ludhiana Circle— Percentage of success 72.6 per cent.
5	Ferozepore ...	62	39	
6	Lahore ...	64	51	
7	Montgomery ...	27	20	
8	Multan ...	8	8	
9	Bahawalpur ...	2	2	
		216	157	
10	Jullundur ...	32	22	Jullundur Circle— Percentage of success 59 per cent.
11	Hoshiarpur ...	105	54	
12	Amritsar ...	27	27	
13	Amritsar ...	33	13	
14	Sialkot ...	3	3	
15	Rawalpindi ...	3	2	
16	Campbellpur ...	4	1	
17	Gujrat ...	3	2	
		210	124	
	Total	538	379	69.33 per cent. success.

Appendix B.

DETAIL OF STRAINERS USED IN WELLS IN THE PUNJAB.

District.	Strainer No.	Average yield of well before strainer was used in gallons.	Yield after strainer was used in gallons.	Average cost per well.	REMARKS.
		<i>Prior to</i>	<i>July 1916.</i>	Rs. A. P.	
Hoshiarpur ...	8	562	2,163	51 2 9	Jullundur Circle.
Amritsar ...	9	768	2,638	93 8 9	
Ludhiana ...	9	500	2,000	68 0 0	Ludhiana Circle.
Montgomery ...	4	637	2,519	51 0 0	
Karnal ...	1	400	4,300	120 0 0	Rewari Circle.
<i>Since July 1916 to June 1917.</i>					
Jullundur ...	1	391	3,106	83 10 0	Jullundur Circle.
Hoshiarpur ...	44	619	2,163	76 9 9	
Amritsar ...	22	768	2,638	85 9 9	
Sialkot ...	3	469	1,938	71 3 6	
Montgomery ...	12	637	2,519	51 0 0	Ludhiana Circle.
Lahore ...	47	672	2,269	74 3 0	
Multan ...	6	412	1,919	107 0 0	
Ludhiana ...	5	500	2,000	68 0 0	
Gurgaon ...	2	500	3,500	150 0 0	Rewari Circle.
Karnal ...	2	1,000	3,900	120 0 0	

Appendix C.

TUBE WELLS.

Completed during 1916-17.

FOR general irrigation purposes, each tube yielding over one cusec discharge—

- (1) *District Mianwali.*—Village Kamarmashani, near railway station; installed at Government cost.
- (2) *District Amritsar.*—Village Kishanpur, near Jandiala, owner Thakur Mahan Chand, Honorary Magistrate.
- (3) *District Ferozepore.*—Situation District Board Gardens, put in by the District Board.
- (4) *District Gurdaspur.*—Village Dhapai, 10 miles from Batala, owner Bhai Harbans Singh, Contractor, Khanki.
- (5) *District Lahore.*—Tube sunk in Mozang section of municipal area by Lahore Municipal Committee. Complete plant required for 20,000 gallons per hour for public water-supply.
- (6) *District Amritsar.*—Ajnala Tahsil, installed by the District Board for general irrigation purposes.

APPENDIX VI.

Report of the Professor of Agriculture on the Lyallpur Farm and on district work in the Lower Chenab and Lower Bari Doab Colonies.

THE rainfall for the season totalled 9.39 inches, as compared with 3.04 inches for the previous year and an average of 11.98 inches in 5 years and 14.19 inches for 10 years, see statement 1. The comparatively heavy rain in August, (4.67 inches) combined with a cold October promised badly for American cotton, but as events turned out the crop did excellently except in a few parts of the Lyallpur District. The season, apart from unusual shortage—of canal water, was favourable for wheat. The very cool spring favoured late wheats, but hail-storms did local damage of some seriousness, especially to early wheats. No rain fell from the beginning of November to the end of February. In April 1.48 inches fell. Observation here appears to show that absence of rain during the wheat flowering season in February is very favourable for fertilization, though the crop itself, especially in barani (rain-fed) tracts, may be suffering from lack of moisture in the soil. As might be expected in a dry year there was comparatively little rust. The season was on the whole favourable for irrigated tracts.

EXPERIMENTS AT THE FARM : ALL ON CANAL IRRIGATED LAND.

Cultural and other experiments in area C, square 27, with wheat, maize and sugarcane.

In this area up to 1916 the rotation was sugarcane, maize, cotton. The manurial experiment with sugarcane had shown that artificials added to bulky manures, as farm yard manure and castor cake, did not pay, and were liable to affect the quality of the gur.

The rotation now is maize, senji (as a catch crop), sugarcane, wheat; farm yard manure is given to the maize only. The above rotation is common in chabi (well irrigated) areas. The plots will be under cultural and varietal experiments.

Wheat.—harrowing versus no harrowing.—There was no rain after sowing and the first watering was given as late as January 26th. Hence conclusive results are not to be expected; yields were high,—*vide* statement 2.

Maize.—sowing in lines and broadcast.—Season very unfavourable for maize and borer attack was serious,—*vide* statement 3 (a).

Senji in the 'wadh' of maize (that is grown immediately after it) has done much better in case of line plots which received 7 hoeings. Plots 1 and 4 and 2 and 3 are adjacent,—*vide* statement 3 (b).

Sugarcane.—No experiment. Plot testing only—yields good, Statement 4.

Manurial experiments with sugarcane, maize and cotton in the kharif series, and toria, gram and wheat in the rabi series.

See 1911-12 report for details and statements 5, 6, 7, 8, 9 and 10 for this year's results.

This series will be discontinued after this year as no useful result can be anticipated from these tests, which were laid out by my predecessor, Mr. Corbin. A note on the whole experiment, together with other manurial experiments carried out to date is being written by Mr. Faulkner.

Toria in square 27,—*vide* statement 4 (a).

Wheat variety trials types 11, 8 A and 8 B.—See statements 11 (a) and 11 (b). Attention was drawn in the last annual report to types 8 A, 8 B and 17 B received from the Economic Botanist. This year types 8 A and 8 B were compared with No. 11 in adjacent plots in square 26 and with tenants. In statement 11 (a) the results after wheat are given and in 11 (b) after cotton. As the northern part of the plots is more sandy the crop is always harvested in two portions. Results are summarized below :—

Area.	Plot.	Variety.	Increase or decrease as compared with No. 11.			
			Outturn per acre.		Mds. Srs.	
		No.	Mds.	Srs.	Mds.	Srs.
26 A	a ₁	11	21	28	...	...
	a ₂	8 A	22	10	+ 0	22
	a ₃	8 B	15	26	- 6	2
	b ₁	11	21	7	...	...
	b ₂	8 A	21	12	+ 0	5
	b ₃	8 B	20	30	- 0	17
Average for whole acre is—			No.	Mds. Srs.	Mds.	Srs.
		11	21	18½	...	...
		8 A	21	31	+ 0	12½
		8 B	18	8	- 3	10½

After cotton—

Area.	Plot.	Variety.	Yield.		Increase or decrease as compared with No. 11.	
					Mds.	Srs.
26-A-3	a_1	No. 11	19	12	...	...
	a_2	8 A	19	26	+0	14
	a_3	8 B	14	20	-4	32
	b_1	No. 11	29	34	...	...
	b_2	8 A	32	26	+2	32
	b_3	8 B	25	32	-4	2

Average for whole acre works out as follows :—

No.	Mds.	Srs.	Mds.	Srs.
11	24	23	...	...
8 A	26	6	+ 1	23
8 B	20	6	- 4	17

It will be seen that 8 A proved to be consistently the best. The season was, however, very favourable to late wheats. No. 8 A is later than No. 11 and No. 8 B earlier. Trials carried out with tenants as usual confirm above results—*vide* statements 12, 13 and 14. No. 8 A was compared with No. 11 in eight different plots. One test is rejected as area under 8 A had been manured for sugarcane in 1915—*vide* statement 12. Taking the remaining 7 we find that on the average Punjab 11 yielded maunds 14-38 and No. 8 A yielded maunds 15-23 or an average of 25 seers more per acre.

No. 8 B was tested in 8 plots also with tenants and yielded less in every plot, the average being as follows :—

No.	Mds.	Srs.
11	...	...
8 B	...	...

No. 8 B and to some extent No. 11 suffered materially from shedding due to hailstorms. The tests will be repeated.

Pusa 12 and Punjab 17,—vide Statement 14—

It has been conclusively proved in previous experiment that Pusa 12 is inferior in yield to Punjab 11. It was thought, however, that an early wheat like Pusa 12 might replace No. 17 to some extent. In 10 tests out of 13 No. 17 yielded better, the average outturn being as follows :—

	Mds.	Srs.
Punjab 17	...	...
Pusa 12	...	...

As in case of No. 8 B, Pusa 12 suffered from hail to a greater extent than Punjab 17. This test will be repeated. Incidentally it may be noted that our tenants have become rather wideawake and object to growing No. 8 B and Pusa 12 already. Similarly they demand compensation for growing country cottons in place of Americans since 1911, the year which in my opinion was the first landmark in the successful introduction of American cotton.

It may be noted here that 150,000 acres of pure No. 11 is expected to be sown in the colonies this coming rabi season, compared with 100,000 acres in the year under report.

A fuller account of the wheat variety trials has been sent for publication in the *Agricultural Journal*.

Cotton experiments

Ridging as compared to flat lines with American cotton.—It is the universal practice in the United States of America to sow cotton in lines and in most cases to slightly ridge it : (*vide* report of my tour in United States of America, 1916).

Statement 15 gives results in square 26. The yields are very similar but much less water was used with ridged cotton ; approximately two-thirds only after first two waterings. Extended trials are being carried out in this matter in the present season.

Sowing in lines versus broadcast.—*Vide statement 16.*

Hydraulic experiments.—The experiment is very instructive, and the difference between the four plots sown in lines and inter-cultured and the plots sown broadcast was very marked and easily discernible to the eye. The average yield in lines plots = 9 maunds 6 seers and broadcast = 7 maunds 6 seers.

The amount of water used which was measured was also distinctly less in case of cotton sown in lines. The sowing of American cotton in lines is gaining ground in the colony—*vide account of district work given later.*

Comparison of two and three waterings for wheat.—Statement 17.

Results are inconclusive, but show that in this case two waterings were generally sufficient. Whether two or three are used really depends on date of first watering and condition of the crop. Thus if the first watering is given at the end of January, then two waterings after sowing will be ample as a rule. See also statement 2, where no appreciable difference is seen.

In the new area, however, had the crop not been watered in March, it would have largely dried up. In this connection statement 18 on manurial experiments in square 17 is instructive. Owing to shortness of water only 5 plots got 3 waterings with, as will be seen, a marked increase in yield.

Different number of kiaries per acre for irrigating wheat.—See statement 19. Chief feature is low total of water taken per crop, *i.e.*, generally under 10 inches.

Toria.—Heavy and light flow of irrigation—see statement 20. Practically the same amount of water has been used throughout. Experience shows first watering to be dangerous when it comes with a heavy flow. Different numbers of waterings will be tried for toria in future.

Toria : number of kiaries.—*Vide statement 21.*

Cotton : number of kiaries.—*Vide statement 22.*

NOTE.—Total quantity of water used very high with 4 kiaris and especially in first watering. Water used varies from 17" to 20".

Calcium nitrate on wheat.—Statement 23.

These four plots have grown wheat continuously since the institution of the experiment in 1908-09. The land has got into bad heart and yield even with manure is low; results inconclusive.

Green manuring experiments square 2, statements 24 and 25.—This is a permanent experiment started in 1915. There are three blocks of land one of which is green manured each year in rotation, the whole area being under wheat. The object is to compare the efficiency of various green manures with san (hemp). The experiment will be discussed after first complete cycle, *i.e.*, next year. A somewhat similar test to test guara and san initiated on the Students' Farm in 1913 in two separate series appear to show the distinct superiority of guara over san for green manuring. This aspect is being further studied.

Hot weather ploughing for wheat.—Statement 26.

As in previous years, results show a little advantage in favour of hot weather ploughing. The experiment will be modified, in that in future the hot weather plots will be late ploughed and *vice versa*.

Manurial and variety experiments with sugarcane.—Statements 27 and 28. Mohwa cake added to farm yard manure produced no increase.

Bone meal and gypsum on toria, wheat and cotton.—*vide statements 29, 30, 31 and 18.*—Increases in yield were produced but far too little to pay for the manure. The residual effect on cotton was very small.

Cotton variety trials.—The only two American varieties besides 4 F being tried are 275 F and 280 F. 280 F is smoother leaved than 4 F and hence more liable to leaf curl. The ginning percentage of 280 F is 31 per cent. as compared to 33 per cent. for 4 F. Statement 32 (a) gives this year's results. It will be seen that in an average of 10 plots 4 F does better by 13 seers per acre than 275 F, and better than 280 F by $19\frac{7}{8}$ seers per acre. In 10 plots against 275 F the yield is less in case of 4 F in two only and in 12 against 280 F it is less in five only. The lint of 280 F is worth 7d. per lb. at least when 4 F is 6d. As, however, 280 F is a more delicate plant than 4 F, it would be risky to put it out on a large

scale to zamindars, but the trials will be extended in future as its possibilities are distinctly favourable. Average yields in 1915 were as follows :—

	4 F.	280 F.	4 F.	275 F.
	Mds. Srs.	Mds. Srs.	Mds. Srs.	Mds. Srs.
Average of plots ...	8 18	10 6	4 30	4 31

and in 1914-15 as follows :—

	4 F.	280 F.	4 F.	275 F.
	Mds. Srs.	Mds. Srs.	Mds. Srs.	Mds. Srs.
	4 4	3 15	5 0	3 25

1914-15 being an unfavourable year for cotton brings out truth of remarks above regarding hardness of 4 F.

The following varieties of American cotton handed over by Economic Botanist have been grown up-to-date :—

Variety.	Year of banding over.	Year discarded.	REMARKS.
Dharwar (no number),...	1909	1910-11	Poor in quality and yield.
3 F ...	1910	1913-14	Smooth leaved and suffered severely from leaf curl,—vide Annual Report for 1914.
4 F ...	1910	Continues	Good, hardy variety.
161 F ...	1911	1912-13	Yield poor.
126 F ...	1911	1913-14	Showed no particular qualities. Discarded for want of space.
179 F ...	1912	1913-14	Leaf curl as plants smooth leaved.
168 F ...			
266 F ...		1915-16	Poor yielder.
280 F ...		Continues	Partly smooth leaved but lint excellent.
199 F ...	1913	1913-14	Late and no particular quality discarded for want of space.
275 F ...	1913	Continues	Rough leaved, but staple short.

Desi (country) cottons.—See statements 32 (b) (i) and (b) (ii).

This year Mollisoni (white flowered Indicum) comes out best, being better than Rosea in the 8 plots where they were tested alongside each other. Indicum yellow flowered gave a low yield again, yet in the country cotton growing in zamindars' fields everywhere this is the most common type, generally occupying 70 per cent. to 80 per cent. at least of the field. It is possible that the variety of Indicum (135 A) we are testing is not a good one, and that another variety might do better. Yellow flowered Neglectum is slightly better than Rosea but as the ginning percentage of the former is lower, viz., 14½ seers per maund as compared with 15½ seers for Rosea, the difference in value per acre is largely in favour of Rosea. Last year's results (vide statement 14 of 1915-16 report) shows the overwhelming superiority of Rosea over all other types. Some seed of Rosea has been given out to Major Vanrenen and to Rai Sahib Sewak Ram for further testing. Further work is necessary before any general distribution of seed is feasible.

Miscellaneous experiments.

Mangel wurzels.—Vide statements 33 (a) and (b).

Long Red variety has given the best results throughout, and the best spacing is apparently 24 inches. Some seed of Long Red will be given out for trial to selected zamindars this year.

Other fodder experiments.—Shaftal has again done very well at the students' farm and promises to become useful in the colony. It is a better food than senji and gives 2 or 3 cuttings. Japan sarson is also giving encouraging results.

College dairy.—The average yield of milk of the cows has gone up considerably as a result of selection and rejection of unprofitable cows. The present yield is 6.8 lbs. per cow for the whole herd, as compared with 5.4 lbs in 1915-16. Useful feeding trials are being conducted but owing to the smallness of the number of animals these are limited. A separate area has been put aside for fodder growing for the dairy.

District work.—The circle in my charge comprises at present the districts of Lyallpur, Jhang, Montgomery, Gujranwala and the Chunian Colony. The various lines of work will be discussed separately.

Reaping machines.—One hundred and twenty-three reapers were inspected by my staff and 73 of these were cleaned and overhauled before harvest started. The season was unfavourable for reapers for many reasons, such as high price of spares, damage to crop by hail and cheap labour, owing to large numbers of labourers coming in from barani tracts and from Jammu.

A killa of wheat could be cut this year for Rs. 3 instead of usual Rs. 5 or Rs. 6. The Narbadda Reaper, which is a modification of the Rajah, was tried this year and seems to work much better than the Rajah. The Narbadda Reaper is recommended in the Central Provinces by Mr. Evans.

Steam thresher.—There was very little demand for this owing to difficulty of shifting the machine with bullocks. Plenty of zamindars would be glad to have it otherwise. A tractor would be expensive, and with present war prices there is very little prospect for steam threshing machinery.

A bullock thresher from Dharwar was tried and gave promising results.

Wheat seed farms, type No. 11.—Some 20,000 maunds of Punjab 11 were stored and all save 3,000 maunds were sold. Much of this amount of 3,000 maunds had been stored by zamindars who expected the Department to do all the selling for them whereas others sold the whole quantity kept with them. In addition to above a good deal of seed was stored separately by zamindars, so that the pure No. 11 in the Chenab Canal Colony was estimated at 60,000 acres. There was, in addition, some 15,000 acres in Montgomery and probably 25,000 acres at Sargodha, making a total of 100,000 acres. It was very difficult to arrange for seed for 1917 as owing to short canal supply in February and March crops were uncertain and areas could not be selected. The frequent rains since harvest rendered much of the wheat unsuitable for storing for seed. However a total quantity of over 25,000 maunds will be available next rabi apart from that stored by zamindars. Excellent reports were received of this wheat, not only from canal tracts, but also from chahi and barani areas in Gujranwala. The extra profit to the colonies from the growing of this wheat is estimated at a minimum of 3 lakhs for 100,000 acres.

Cottons.—American cotton work was again very successful. The Department disposed of 10,345 maunds of seed besides the quantities stored by big zamindars like Rai Sahib Sewak Ram and others. The total area under the Department's seed is estimated at 120,000 acres. Besides above one or two factories have sold large quantities of moderately pure seed. The total area under American was estimated in May as 200,000 acres. Later information indicates the figures to be nearer 215,000 altogether. The Lower Bari Doab Canal Colony alone has over 70,000 acres under American of which about 60,000 is from pure seed. The total area under American cotton last year was 125,000 acres. The extra profit from the growing of American last year is estimated at 28 lakhs: this year with a similar high premium of Rs. 4 and satisfactory yield the extra profit should reach 50 lakhs.

The cotton sales organized by the Department this year were very successful as far as their main object was concerned *viz.* the securing of a fair premium for good cotton. Over 41,000 maunds were sold at sales in the Lower Chenab and Lower Bari Doab Colonies. Two of the sales were as such unsuccessful and had to be abandoned—those at Jhang and Tandlianwala. The reason, however, was that local opposition was encountered and better premiums were offered by the opposition than could be secured by the Department. The sales were of great value in Montgomery, where the market is not yet organised and prices before our sales started were as much as Rs. 7 and Rs. 8 per maund less than sale prices. The Punjab Government and the Government of India are arranging to post up Bombay cotton prices in the local markets in the colonies: this will be a very powerful factor in equalising prices and will supplement our efforts with cotton sales. It is anticipated that after a few years these departmental sales will only be necessary in order to secure seed or in the event of our attempting to put on the market a superior cotton to 4 F.

Another reform of importance recently adopted by Government is with regard to minimum conditions to be complied with by all new ginning factories put up. These conditions are being drawn up with a view to facilitate classification of types and to prevent mixing of kapas and lint in the ginning room. An encouraging sign has been the willingness of prospective builders to adopt the reforms suggested: in one case *viz.*, that of Bahadur Singh of Amritsar the owner is arranging to build according to the Department's recommendations, although, having bought his factory site by auction, he is not compelled to do so.

Sowing in lines and interculture.—Chaudhri Muhammad Abdulla, my chief assistant in district work reports, and I agree with him, "that the practice of sowing cotton, especially American in lines, and interculturing is becoming the rule rather than the exception in certain villages." In 1916 American cotton was sown in lines in 586 killas in Lyallpur and 200 killas in Montgomery. In the present season some thousands of acres have altogether been sown in lines. The reports received are very satisfactory and encouraging.

Country implements.—Sowing drills and bar harrows are increasing in popularity. Of the former 85, and of the latter 54 have been issued, and the demand is still very strong though they can both be made in the villages. Bar harrows have been particularly useful this spring in hoeing cotton and sugarcane after the frequent showers which came in April and May, besides their use for the wheat crop. Great progress is anticipated in the coming season. The Lyallpur hoe which has been developed to replace the Gujrati hoe, though still under trial, had to be supplied to 46 people at their own request. A consignment of 20 horse hoes from America received in April was rapidly disposed of, and 12 orders still remain on our hands. These cost over Rs. 50 each, and are used for interculturing. The prospects for a moderately priced home article are therefore very bright. The Lyallpur hoe, which was an adaptation of the Akola hoe, was first tried by Mr. Faulkner in 1916; since then some improvements have been made, but it is not yet quite satisfactory.

Ploughs.—Improved inverting ploughs with some novel departures from precedent such as doing away with wheels, hakes etc., have been tried, and will be sent to the manufacturers, who are expected to send out consignments in the near future. These 'Lyallpur ploughs' are expected to replace the 'Rajah', 'Punjab' and 'Jat' ploughs, none of which are entirely satisfactory, especially as regards price. There is a keen demand for chaff cutters but they are not available. Mr. Faulkner is co-operating with me in all the above work and is besides making a study of the 'toria' crop.

W. ROBERTS,

Professor of Agriculture, Punjab, Lyallpur.

Statement 1.

RAINFALL FOR THE LAST TEN YEARS (1907-08 TO 1916-17).

Serial No.	Year.						Rainfall.	REMARKS.
							Inches.	
1	1907-08	...	...	...	...	...	8.08	
2	1908-09	...	...	...	...	...	25.50	
3	1909-10	...	...	...	...	...	21.01	
4	1910-11	...	...	...	...	...	19.75	
5	1911-12	...	...	...	...	...	7.73	
6	1912-13	...	...	...	...	...	9.57	
7	1913-14	...	...	...	...	...	16.84	
8	1914-15	...	...	...	...	...	21.05	
9	1915-16	...	...	...	...	...	3.04	
10	1916-17	...	...	...	...	...	9.39	
Total for the last 5 years						...	59.89	
Average						...	11.98	
Total for the last 10 years						...	141.96	
Average						...	14.19	

Statement 2.

RESULTS OF HARROWING *VERSUS* NO HARROWING ON WHEAT GROWN IN ROTATION SERIES,
AREA C, SQUARE 27, RABI 1916-17.

No. of square and plot.	No. of sub-plot.	Name of crop.	Treatment.	Area in acres.	ACTUAL OUTTURN.				OUTTURN PER ACRE.				REMARKS.
					Grain.		Bhusa.		Grain.		Bhusa.		
					Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
27 C 3	1	Punjab type 11.	No harrowings, 3 waterings.	1	7	32	14	1	31	8	56	4	Ploughing 12
	2		Harrowing, 3 waterings.	1	8	6	14	18	32	24	57	32	Harrowing 15
	3		No harrowing, 2 waterings.	1	8	10	16	8	33	0	64	32	Sohagaing 18
	4		Harrowing, 2 waterings.	1	6	24	12	20	26	18	50	0	Harrowing to plots 2, 4, 6 and 8.
	5		No harrowing, 3 waterings.	1	7	38	13	29	31	34	54	38	Date of sowing—7th November 1916.
	6		Harrowing, 3 waterings.	1	7	19	14	38	29	36	59	32	Date of harvesting—20th and 21st April 1917.
	7		No harrowing, 3 waterings.	1	8	4	16	25	32	16	66	20	
	8		Harrowing, 3 waterings.	1	7	9	16	37	28	36	67	28	

Statement 3 (a).

RESULTS OF DIFFERENT METHODS OF SOWING MAIZE IN ROTATION SERIES AT THE LYALLPUR AGRICULTURAL STATION, KHARIF 1916.

No. of square and plot.	No. of sub-plot.	Name of variety.	Treatment.	AREA.		WEIGHT OF DRY STALKS.		WEIGHT OF FRESH COBS.		WEIGHT OF DRY COBS.		WEIGHT OF GRAIN.		YIELD PER ACRE.		REMARKS.
				Kanals.	Marlas.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
27 C1	1	Red local maize.	Lines 2 feet apart ...	4	0	14	28	11	25	9	17	7	29	15	18	Borer attack was very bad and the crop in lines suffered to a great extent. This rendered results inconclusive.
	2		"Kera" - sown by hand behind country plough.	4	0	20	22	17	15	14	4	11	27	23	15	Ploughing ... 8 Harrowing ... 10 Schagaing ... 12
	3		Lines 2 feet apart ...	4	0	20	4	17	9	13	39	11	24	23	9	Hoing and weeding 7 Watering ... 3
	4		"Kera" - sown by hand behind country plough.	4	0	21	28	19	3	15	11	12	30	25	21	Date of sowing—29th and 30th July 1916. Date of harvesting—2nd and 4th November 1916.

Statement 3 (b).

OUTTURN OF SENJI (MELILOTUS PARNIFLORA) GROWN IN SQUARE 27, AREA C, ROTATION SERIES, 1916-17.

No. of square and plot.	No. of sub-plot.	AREA.		ACTUAL OUTTURN.		OUTTURN PER ACRE.		REMARKS.
		Kanals.	Marlas.	Maunds.	Seers.	Maunds.	Seers.	
27 C1	1	4	0	70	28	141	16	After maize sown in lines.
	2	4	0	76	22	153	4	" " by "kera."
	3	4	0	90	12	180	24	" " in lines.
	4	4	0	58	18	116	36	" " by "kera."

Number of waterings ... 5.

Date of sowing—25th September 1916.

Date of harvesting—Plot 1, 15th February to 18th February 1917.

Plot 2, 19th February to 2nd March 1917.

Plot 3, 20th February to 27th February 1917.

Plot 4, 15th February to 19th February 1917.

Plot 1 compares with plot 4.

Plot 2 compares with plot 3.

Statement 4.

OUTTURN OF SUGARCANE GROWN IN ROTATION SERIES, AREA C, SQUARE 27, KHARIF 1916.

No. of square and plot.	No. of sub-plot.	Name of variety.	AREA.		WEIGHT OF GREEN TOPS.		WEIGHT OF CANES.		WEIGHT OF JUICE.		WEIGHT OF GUR.		YIELD OF GUR PER ACRE.		Percentage of green tops to canes.	Percentage of juice to cane.	Percentage of gur to juice.	Percentage of gur to cane.	REMARKS.
			Kanals.	Marlas.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.					
27 C 2	1	Katha.	2	0	49	8	76	34	40	34	8	16	33	25	64	53.15	20.59	10.94	Ploughing ... = 5
	2		2	0	56	38	91	21	51	6	9	27	38	31	62.23	55.49	18.95	10.59	Harrowing ... = 3
	3		2	0	58	1	92	26	42	20	7	30	31	0	59.81	45.86	18.24	8.366	Sohagaing ... = 11
	4		2	0	59	35	97	8	36	27	7	0	28	0	61.60	37.73	19.09	7.202	Hoeing and harrowing ... = 7
	5		2	0	52	12	111	21	52	28	10	1	40	6	46.90	47.26	19.04	9.001	Watering ... = 15
	6		2	0	47	26	111	11	54	2	10	19	41	38	42.82	48.57	19.40	9.42	Date of sowing—1st and 2nd April 1916. Crushing began on 10th January 1917 and finished on 6th February 1917.
	7		2	0	52	32	104	23	50	20	9	29	38	36	50.49	48.28	19.26	9.298	
	8		0	12	15	12	28	35	16	0	3	3	41	6	53.03	55.4	19.3	10.69	

Statement 4 (a).

OUTTURN OF TORIA GROWN IN SQUARE 26, 1916-17.

No. of square and plot.	No. of sub-plot.	Name of crop.	Previous crop.	Area in acres.	ACTUAL OUTTURN.				YIELD PER ACRE.		REMARKS.
					Grain.		Straw.		Maunds.	Seers.	
					Maunds.	Seers.	Maunds.	Seers.			
26 A 1	a ₁	Torla.	Wheat.	1/2	6	34	13	24	13	28	Ploughing ... = 3
	b ₁			1/2	7	26	15	18	15	12	Harrowing ... = 14
	a ₂			1/2	5	12	11	8	10	24	Sohagaing ... = 6
	b ₂			1/2	7	5	16	10	14	10	Watering ... = 3
	a ₃			1/2	6	25	12	10	13	10	Date of sowing—14th September 1916.
	b ₃			1/2	7	35	14	18	15	30	Date of harvesting—22nd January 1917 to 5th February 1917.

Statement 5.

OUTTURN OF SUGARCANE, AREA D, STANDARD K, SQUARE 27, KHARIF 1916.

No. of square.	No. of plot.	Variety.	Treatment.	Area in acres.	WEIGHT OF TOPS.		WEIGHT OF CANES.		WEIGHT OF JUICE.		WEIGHT OF GUR.		YIELD OF GUR PER ACRE.		Percentage of green tops to canes.	Percentage of juice to canes.	Percentage of gur to juice.	Percentage of gur to canes.	REMARKS.
					Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.					
27 D/K.	1	Katha.	Unmanured ...	13 ⁷ / ₁₀	1	20	1	30	0	35	0	5	4	18	85.7	50	14.29	7.14	Ploughing ... 4
	2		Super phosphate at 231 lbs. per acre.	1 ¹ / ₂	40	21	57	15	31	18	5	17	27	5	70.6	54.8	17.25	9.4	Harrowing ... 8
	3		Unmanured ...	3 ⁷ / ₁₀	10	17	16	23	7	24	1	16	24	38	62.8	45.85	18.4	8.4	Sohagaing ... 15
	4		Bone meal at 2 cwts. 80 lbs. per acre.	1 ¹ / ₂	40	7	76	22	39	9	7	6	35	32	52.4	51.2	18.2	9.3	Hoeing and harrowing 9
	5		Unmanured ...	3 ⁷ / ₁₀	12	1	20	18	10	30	2	2	36	31	58.8	52.5	19.1	10.08	Watering ... 13
	6		Farm yard manured at 4 tons per acre.	1 ¹ / ₂	48	19	76	14	41	3	7	23	37	36	63.4	53.7	18.4	9.9	Date of sowing—26th March 1916.
	7		Unmanured ...	3 ⁷ / ₁₀	11	27	15	31	7	35	1	19	26	12	74.00	48.9	18.8	9.3	Crushing began on 26th December 1916.
	8		Basic slag at 8 maunds per acre.	1 ¹ / ₂	36	21	59	4	33	5	5	34	29	10	61.8	56.04	17.6	9.8	Crushing finished on 9th January 1917.
	9		Unmanured ...	3 ⁷ / ₁₀	10	13	15	6	8	12	1	27	29	35	68.1	54.7	20.1	11.5	
	10		Lime at 5 cwts. per acre.	1 ¹ / ₂	36	25	55	12	30	39	5	15	26	37	66.2	56.01	17.3	9.7	
	11		Unmanured ...	13 ⁷ / ₁₀	3	30	3	25	1	23	0	12	10	28	103.4	43.4	19.04	8.2	

Statement 6.

OUTTURN OF MAIZE GROWN IN THE MANURIAL BLOCK, AREA D, STANDARD K, KHARIF 1916.

No. of square and plot.	No. of sub-plot.	Variety.	Treatment.	Area in acres.	WEIGHT OF FRESH COBS.		WEIGHT OF DRY COBS.		WEIGHT OF DRY STALKS.		WEIGHT OF GRAIN.		YIELD OF GRAIN PER ACRE.		REMARKS.
					Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
27 D/K.	12	Red local maize.	Unmanured ...	13 ⁷ / ₁₀	0	17	0	14	0	16	0	12	10	28	Ploughing ... 10
	13		Calcium cyanide at 3 cwts. 60.7 lbs. per acre.	1 ¹ / ₂	5	19	3	32	3	1	3	6	15	30	Harrowing ... 16
	14		Unmanured ...	3 ⁷ / ₁₀	0	29	0	24	0	23	0	20	8	36	Sohagaing ... 18
	15		Calcium nitrate at 6 cwts. 34.6 lbs. per acre.	1 ¹ / ₂	3	5	2	25	2	20	2	7	10	35	Hoeing and weeding 5
	16		Unmanured ...	3 ⁷ / ₁₀	...	34	0	30	0	30	0	25	11	14	Watering ... 4
	17		Farm yard manure at 4 tons per acre.	1 ¹ / ₂	3	35	3	13	2	28	2	32	14	0	Date of sowing—28th July 1916.
	18		Unmanured ...	1 ¹ / ₂	0	25	0	22	0	24	0	19	13	165	Date of harvesting—1st November 1916.
	19		Ammonium sulphate at 3 cwts. 10.2 lbs. per acre.	1 ¹ / ₂	3	2	2	25	2	16	2	5	10	25	
	20		Unmanured ...	3 ⁷ / ₁₀	0	27	0	26	0	25	0	21	9	14	
	21		Gypsum at 5 cwts. per acre.	1 ¹ / ₂	2	14	2	5	2	2	1	30	8	30	
	22		Unmanured ...	13 ⁷ / ₁₀	0	4	0	3	0	8	0	3	2	27	

Statement 7.

OUTTURN OF COTTON GROWN IN MANURIAL BLOCK, AREA D, STANDARD K, SQUARE 27, KHARIF 1916.

No. of square.	No. of plot.	Name of variety.	Treatment.	Area in acres.	ACTUAL OUTTURN.		OUTTURN PER ACRE.		REMARKS.
					Maunds.	Seers.	Maunds.	Seers.	
27	23	Farm selected broad leaf sanguineum cotton.	Unmanured ...	$\frac{37}{1830}$	0	24	22	2	Ploughing ... 4
	24		Lime at 5 cwt. per acre and bone meal at 2 cwt. 80 lbs. per acre.	$\frac{37}{1830}$	2	2	10	14	Harrowing ... 8
	25		Unmanured ...	$\frac{37}{1830}$	0	24	11	0	Hoeing ... 6
	26		Lime at 5 cwt. per acre and ammonium sulphate at 3 cwt. 10.2 lbs. per acre.	$\frac{37}{1830}$	2	27	13	18	Sohagaing ... 10
	27		Unmanured ...	$\frac{37}{1830}$	0	23	10	20	Waterings ... 6
	28		Farm yard manure at 4 tons per acre.	$\frac{37}{1830}$	2	14	11	32	Date of sowing—10th April 1916.
	29		Unmanured ...	$\frac{37}{1830}$	0	24	10	30	Pickings began on 2nd October 1916.
	30		Bone meal 2 cwt., 80 lbs. per acre, lime at 5 cwt. and ammonium sulphate 3 cwt. 10.2 lbs. per acre.	$\frac{37}{1830}$	3	12	16	24	Pickings finished on 30th December 1916.
	31		Unmanured ...	$\frac{37}{1830}$	0	30	13	27	
	32		Superphosphate at 231 lbs. per acre, calcium nitrate at 6 cwt., 34.6 lbs. per acre and ammonium sulphate 3 cwt., 10.2 lbs. per acre.	$\frac{37}{1830}$	3	31	18	36	
	33		Unmanured ...	$\frac{37}{1830}$	0	27	12	3	

Statement 8.

OUTTURN OF TORIA GROWN IN THE MANURIAL BLOCK, AREA D, STANDARD R, SQUARE 27, 1916-17.

No. of square.	No. of plot.	Name of crop.	Treatment.	Area in acre.	ACTUAL OUTTURN OF				YIELD OF GRAIN PER ACRE.		REMARKS.
					Grain.		Straw.		Maunds.	Seers.	
					Maunds.	Seers.	Maunds.	Seers.			
27	23	Torja	Unmanured ...	$\frac{37}{1830}$	0	13	0	28	11	23	Badly lodged; ripening late and irregular.
	24		Bone meal 4 cwt. 42 lbs. and lime at 5 cwt. per acre.	$\frac{37}{1830}$	2	13	4	37	12	12	
	25		Unmanured ...	$\frac{37}{1830}$	0	22	1	36	9	32	
	26		Lime at 5 cwt. per acre and ammonium sulphate at 3 cwt. 10.2 lbs. per acre.	$\frac{37}{1830}$	3	13	6	20	16	27	
	27		Unmanured ...	$\frac{37}{1830}$	0	23	1	38	10	10	Badly lodged and ripening late and irregular.
	28		Farm yard manure at 4 tons per acre.	$\frac{37}{1830}$	2	36	5	38	14	20	
	29		Unmanured ...	$\frac{37}{1830}$	0	28	2	4	12	28	
	30		Lime at 5 cwt. per acre, bone meal at 4 cwt. 42 lbs., and ammonium sulphate at 3 cwt. 10.2 lbs. per acre.	$\frac{37}{1830}$	3	25	8	20	18	5	
	31		Unmanured ...	$\frac{37}{1830}$	0	33	2	32	14	37	Very late; lodging 95 per cent.
	32		Super-phosphate at 231 lbs., calcium nitrate at 5 cwt., 31 lbs., and ammonium sulphate at 3 cwt. 10.2 lbs.	$\frac{37}{1830}$	3	31	10	15	18	37	
33	Unmanured ...	$\frac{37}{1830}$	0	38	2	24	16	37			

Ploughing ...

Harrowing ...

Sohagaing ...

Watering ...

Date of sowing—6th September 1916.

Date of harvesting—18th January 1917 to 16th February 1917.

Statement 9.

OUTTURN OF GRAM GROWN IN THE MANURIAL BLOCK, AREA D, STANDARD R, SQUARE 27, RABI 1916-17.

No of square.	No. of plot.	Name of gram.	Treatment.	Area in acre.	ACTUAL OUTTURN.				OUTTURN PER ACRE.				REMARKS.
					Grain.		Bhusa.		Grain.		Bhusa.		
					Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
27	1	Local gram.	Unmanured ...	$\frac{37}{1330}$	0	7	0	6	6	9	5	14	
	2		Superphosphate at 23.1 lbs. per acre.	$\frac{1}{2}$	2	39	4	19	14	35	22	15	Ploughing = 3
	3		Unmanured ...	$\frac{37}{880}$	0	39	1	1	17	25	18	11	Harrowing = 15
	4		Bone meal at 6 maunds per acre.	$\frac{1}{2}$	3	27	4	39	18	15	24	35	Sohagaing = 6
	5		Unmanured ...	$\frac{37}{880}$	1	1	1	10	18	11	22	12	Hoing and harrowing = 2
	6		Farm yard manure at 4 tons per acre.	$\frac{1}{2}$	4	3	5	5	20	15	25	25	Watering = 2
	7		Unmanured ...	$\frac{37}{880}$	1	0	1	25	17	33	28	39	Date of sowing—13th October 1916.
	8		Basic slag at 5 maunds 15 seers per acre.	$\frac{1}{2}$	4	7	6	37	20	35	34	25	Date of harvesting—10th April 1917.
	9		Unmanured ...	$\frac{37}{880}$	1	1	1	36	18	11	33	34	
	10		Lime at 5 cwt. per acre.	$\frac{1}{2}$	4	32	5	10	24	2	26	10	
	11		Unmanured ...	$\frac{37}{1330}$	0	27	0	20	24	2	17	33	

Statement 10.

OUTTURN OF WHEAT GROWN IN THE MANURIAL BLOCK, AREA D, STANDARD R, SQUARE 27, RABI 1916-17.

No. of square.	No. of plot.	Name of crop.	Treatment.	Area in acres.	ACTUAL OUTTURN.				OUTTURN PER ACRE.				REMARKS.
					Grain.		Bhusa.		Grain.		Bhusa.		
					Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
27	12	Wheat Punjab No. 9.	Unmanured ...	$\frac{37}{1330}$	0	27	1	38	24	3	69	22	Germination good; lodging 6 per cent.
	13		Calcium cyanide at 3 cwt. 60.7 lbs. per acre.	$\frac{1}{2}$	5	0	19	26	25	0	98	10	Lodging 9 per cent.
	14		Unmanured ...	$\frac{37}{880}$	1	21	4	38	27	17	88	12	Ditto.
	15		Calcium nitrate at 5 cwt. 31 lbs. per acre.	$\frac{1}{2}$	5	23	16	23	27	35	32	35	Ditto.
	16		Unmanured ...	$\frac{37}{880}$	1	12	4	32	23	7	85	24	
	17		Farm yard manure at 4 tons per acre.	$\frac{1}{2}$	5	17	20	12	27	5	101	20	Lodging 85 per cent.
	18		Unmanured ...	$\frac{37}{880}$	0	35	2	35	24	2	79	2	
	19		Ammonium sulphate at 3 cwt. 10.2 lbs. per acre.	$\frac{1}{2}$	4	26	15	9	23	10	76	5	Attacked by white ants.
	20		Unmanured ...	$\frac{37}{880}$	1	15	8	10	24	21	57	39	
	21		Gypsum at 5 cwt. per acre.	$\frac{1}{2}$	5	0	13	25	25	0	68	5	Growth not so heavy as in other plots.
22	Unmanured ...	$\frac{37}{1330}$	0	11	0	32	9	32	28	21	Showing need of irrigation.		

Ploughing ... = 4
Harrowing ... = 15
Sohagaing ... = 9
Surface harrowing ... = 3

Watering ...
Date of sowing—4th November 1916.
Date of harvesting—24th to 27th April 1917.

Statement 11 (a).

COMPARATIVE TEST OF WHEAT, TYPES 11, 8 A AND 8 B, RABI 1916-17.

No. of square and plot.	No. of sub-plot.	Name of type.	Area in acres.	ACTUAL OUTTURN.				OUTTURN PER ACRE.				Previous crop.	REMARKS.
				Grain.		Bhusa.		Grain.		Bhusa.			
				Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.		
26 A ₂	a ₁	Punjab 11	...	10	34	23	3	21	28	46	6	Wheat	Germination good; tillering fair; badly rusted and attacked by white ants in early stage.
	b ₁	Punjab 11	...	10	23	21	16	21	7	42	32	Do.	
	a ₂	8 A	...	11	5	26	37	22	10	53	34	Do.	Germination good; tillering good; attacked by white ants; late in earing; slightly rusted.
	b ₂	8 A	...	10	26	23	14	21	12	46	28	Do.	
	a ₃	8 B	...	7	33	20	36	15	26	41	32	Do.	Germination good; tillering poor; slightly rusted; strong straw; shedding of grain by hails 10 to 15 per cent.
	b ₃	8 B	...	10	15	25	24	20	30	51	8	Do.	

Ploughing ... 4
 Harrowing ... 12
 Sohagaing ... 7
 Surface harrowing and weeding ... 4
 Watering ... 4
 Date of sowing.—28th October 1916.
 Date of harvesting.—15th to 17th April 1917.

Statement 11 (b).

COMPARATIVE TEST OF WHEAT, TYPES 11, 8 A AND 8 B, RABI 1916-17.

No. of square and plot.	No. of sub-plot.	Area in acres.	Name of variety.	ACTUAL OUTTURN.				OUTTURN PER ACRE.				Previous crop.	REMARKS.
				Grain.		Bhusa.		Grain.		Bhusa.			
				Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.		
26 A 3	a ₁	½	Punjab type 11 ...	9	26	18	7	19	12	36	14	Cotton ...	Germination and tillering good; attacked by white ants; lodging 5 per cent; slightly rusted.
	b ₁	½	Punjab type 11 ...	14	37	29	7	29	34	58	14	Do. ...	
	a ₂	½	8 A ...	9	33	21	15	19	26	42	30	Do. ...	Germination good; tillering very good; lodging 5 per cent.; late in earing; badly lodged after hails.
	b ₂	½	8 A ...	16	13	32	39	32	26	65	38	Do. ...	
	a ₃	½	8 B ...	7	10	13	36	14	20	27	32	Do. ...	Germination good; tillering poor; strong straw; attacked by white ants; shedding of grain by hails 10 to 15 per cent.
	b ₃	½	8 B ...	12	36	28	12	25	32	56	24	Do. ...	

Ploughing ... 4
 Harrowing ... 21
 Sohagaing ... 9
 Surface harrowing ... 4
 Watering ... 3
 Date of sowing.—28th October 1916.
 Date of harvesting.—13th to 19th April 1917.

Statement 12.

COMPARATIVE VARIETAL TESTS OF WHEATS GROWN IN TENANTS' AREA, RABI 1916-17.

No. of square, killa and plot.	Name of variety.	AREA.		ACTUAL OUTTURN.		OUTTURN PER ACRE.		REMARKS.
		Kanals.	Marias.	Mauds.	Seers.	Mauds.	Seers.	
3 — 13	1 Punjab 11 ...	4	4	11	15	21	27	3 waterings on— 29th December 1916 ... 17th February 1917 ... 24th March 1917 ... Crop uniform; tillering fair to good.
3 — 13	2 8 A ...	4	4	10	34	20	26	
7 — 22	1 Punjab 11 ...	4	3	6	35	13	10	3 waterings on— 14th December 1916 ... 18th February 1917 ... 2nd April 1917 ... Germination and tillering good; 8-A attacked by white ants more than Punjab 11.
7 — 22	2 8 A ...	4	3	7	10	13	39	
7 — 23	1 8 A ...	4	4	8	0	15	9	3 waterings on— 14th December 1916 ... 18th February 1917 ... 2nd April 1917 ... Germination and tillering good; attacked by white ants; less rusted than Punjab 11. Tillering and germination good; attacked by white ants; rust present.
7 — 23	2 Punjab 11 ...	4	0	6	25	13	10	
12 — 1	1 Punjab 11 ...	3	15	10	0	21	13	4 waterings on— 18th December 1916 ... 3rd February 1917 ... 3rd March 1917 ... 29th March 1917 ... Germination and tillering good; crop standing very well.
12 — 1	2 8 A ...	3	15	10	10	21	34	
12 — 13	1 Punjab 11 ...	3	19	4	20	9	4	3 waterings on— 22nd December 1916 ... 10th February 1917 ... 30th March 1917 ... Germination and tillering poor; crop patchy on account of patches of kallar; badly attacked by white ants.
12 — 13	2 8 A ...	3	19	4	20	9	4	
12 — 14	1 Punjab 11 ...	3	19	3	10	6	23	3 waterings on— 22nd December 1916 ... 10th February 1917 ... 30th March 1917 ... Tillering poor; crop patchy due to reh patches.
12 — 14	2 8 A ...	3	19	4	36	9	37	
16 — 7,14	1 Punjab 11 ...	3	15	9	4	19	16	3 waterings on— 29th November 1916 ... 20th January 1917 ... 5th March 1917 ... Germination and tillering good; condition fair. Germination good; tillering very good; condition good.
16 — 7,14	2 8 A ...	3	15	9	35	21	2	
16 — 15	1 Punjab 11 ...	3	15	8	20	18	5	3 waterings on— 29th November 1916 ... 11th February 1917 ... 1st April 1917 ... Germination and tillering good; crop fair to good. Plot (2) only manured in 1915 for sugar-cane which failed.
16 — 15	2 8 A ...	3	15	11	28	24	38	
Average outturn.								
Punjab 11 ...		31	10	60	9	15	12	
8 A ...		31	14	67	13	16	39	

Statement 13.

COMPARATIVE VARIETAL TESTS OF WHEATS GROWN IN TENANTS' AREA, RABI 1916-17.

No. of square, killa and plot.	Name of variety.	AREA.		ACTUAL OUTTURN.		OUTTURN, PER ACRE.		REMARKS.	
		Kanals.	Marias.	Maunds.	Seers.	Maunds.	Seers.		
12 — 1 17	Punjab 11 ...	4	6	4	32	8	37	3 waterings on— 22nd December 1916 ... 10th February 1917 ... 30th March 1917 ... Germination and tillering not satisfactory due to presence of reh; crop poor on the whole.	
12 — 2 17	8 B ...	4	6	3	32	7	3		
12 — 1 18	Punjab 11 ...	4	7	5	20	10	4		
12 — 2 18	8 B ...	4	7	3	36	7	7	3 waterings on— 22nd December 1916 ... 10th February 1917 ... 30th March 1917 ... Germination good. Crop patchy due to reh patches; attacked by white ants. Germination fair, tillering poor; crop patchy due to reh patches. Less attacked by white ants than Punjab 11.	
13 — 1 12	Punjab 11 ...	4	2	10	0	19	20		
13 — 2 12	8 B ...	4	2	7	25	14	35		
13 — 1 18	Punjab 11 ...	4	4	11	16	21	28	3 waterings on— 25th December 1916 ... 11th February 1917 ... 28th March 1917 ... Germination fair; tillering better in No. 11. Germination and tillering good; attacked by white ants; rust present. Same as No. 11, but tillering poorer.	
13 — 2 18	8 B ...	4	4	7	4	13	21		
13 — 1 19	Punjab 11 ...	4	10	9	14	16	25		
13 — 2 19	8 B ...	4	10	3	30	6	26	3 waterings on— 30th December 1916 ... 4th March 1917 ... 28th March 1917 ... Condition and tillering fair; rust present. Tillering poor; rust present; growth very poor.	
13 — 1 25	Punjab 11 ...	4	2	10	30	20	39		
13 — 2 25	8 B ...	4	2	9	24	18	29		
16 — 1 10	Punjab 11 ...	4	9	9	20	17	3	2 waterings on— 30th November 1916 ... 11th February 1917 ... Germination and tillering good; a bit patchy due to soil variation. Germination and tillering fair; crop fair. Lodging 5 per cent.	
16 — 2 10	8 B ...	4	9	7	4	12	30		
16 — 1 11	Punjab 11 ...	4	0	10	10	20	20		
16 — 2 11	8 B ...	4	0	6	0	12	0	3 waterings on— 26th December 1916 ... 5th March 1917 ... 31st March 1917 ... Germination good; tillering fair to poor. Crop patchy, poor on the eastern side due to soil variation; suffered for want of irrigation between 1st and 2nd waterings.	
Average outturn.									
	Punjab 11 ...	34	0	71	22	16	33		
	8 B ...	34	0	48	35	11	20		

Statement 14.

COMPARATIVE VARIETAL TESTS OF WHEATS GROWN IN TENANTS' AREA, RABI 1916-17.

No. of square, kills and plots.	Name of variety.	AREA.		ACTUAL OUTTURN.		OUTTURN PER ACRE.		REMARKS.	
		Kanals.	Marsas.	Maunds.	Seers.	Maunds.	Seers.		
$\frac{5}{12}$ 1 ...	Panjab 17 ...	4	7	16	0	29	17	4 waterings on— 19th November 1916 ... 22nd December 1916 ... 20th January 1917 ... 4th February 1917 ...	Soil heavy; tillering good; attacked by birds being near trees.
$\frac{5}{12}$ 2 ...	Pusa 12 ...	4	7	16	25	30	23	...	Tillering good, lodging in both in later stages.
$\frac{7}{18}$ 1 ...	Punjab 17 ...	4	6	9	20	17	20	3 waterings on— 29th December 1916 ... 18th February 1917 ... 24th March 1917 ...	Tillering fair.
$\frac{7}{18}$ 2 ...	Pusa 12 ...	4	6	7	20	13	38	...	Tillering poor, affected by hailstorm.
$\frac{7}{19}$ 2 ...	Punjab 17 ...	4	5	9	5	17	7	3 waterings on— 29th December 1916 ... 18th February 1917 ... 24th March 1917 ...	Tillering fair, less damaged by hailstorm.
$\frac{7}{19}$ 1 ...	Pusa 12 ...	4	5	7	24	14	12	...	Tillering fair, affected by hailstorm.
$\frac{11}{8}$ 1 ...	Punjab 17 ...	3	16	6	2	12	29	4 waterings on— 18th December 1916 ... 3rd February 1917 ... 3rd March 1917 ... 29th March 1917 ...	Poor on the whole. Conditions fairly uniform in both cases.
$\frac{11}{8}$ 2 ...	Pusa 12 ...	3	16	5	16	11	14	...	...
$\frac{12}{7}$ 1 ...	Punjab 17 ...	4	7	7	20	13	31	3 waterings on— 22nd December 1916 ... 10th February 1917 ... 30th March 1917 ...	Crop poor; white ants bad; soil hard with kankar.
$\frac{12}{7}$ 2 ...	Pusa 12 ...	4	7	5	8	9	22	...	...
$\frac{12}{8}$ 1 ...	Punjab 17 ...	4	7	5	20	10	4	3 waterings on— 22nd December 1916 ... 10th February 1917 ... 30th March 1917 ...	Tillering very poor in Pusa 12 with more of shedding by hailstorm.
$\frac{12}{8}$ 2 ...	Pusa 12 ...	4	7	4	24	8	18	...	...
$\frac{13}{7}$ 1 ...	Punjab 17 ...	4	8	14	20	26	14	3 waterings on— 16th November 1916 ... 20th January 1917 ... 4th March 1917 ...	Tillering good.
$\frac{13}{7}$ 2 ...	Pusa 12 ...	4	8	10	34	19	29	...	Tillering poor; badly affected by white ants.
$\frac{13}{8}$ 1 ...	Punjab 17 ...	4	2	10	9	19	38	4 waterings on— 25th December 1916 ... 11th February 1917 ... 5th March 1917 ... 28th March 1917 ...	Tillering good.
$\frac{13}{8}$ 2 ...	Pusa 12 ...	3	18	8	7	15	30	...	Tillering poor with shrivelled grain in part.
$\frac{16}{16}$ 1 ...	Punjab 17 ...	4	2	8	0	15	24	3 waterings on— 26th December 1916 ... 5th March 1917 ... 21st March 1917 ...	Tillering fair. } Suffered for want of water: 17 being a bit higher side was the worst sufferer.
$\frac{16}{16}$ 2 ...	Pusa 12 ...	4	2	11	12	22	2	...	Tillering good.
$\frac{16}{18}$ 1 ...	Punjab 17 ...	4	11	11	0	19	13	3 waterings on— 20th January 1917 ... 5th March 1917 ... 31st March 1917 ...	Crop fair; difference due to the variation in soil; the latter possessed better land a bit low lying.
$\frac{16}{18}$ 2 ...	Pusa 12 ...	4	11	13	4	23	1	...	...
$\frac{19}{11}$ 1 ...	Punjab 17 ...	4	0	10	36	21	32	3 waterings on— 29th December 1916 ... 14th February 1917 ... 30th March 1917 ...	Crop good on the whole, soil showing slight variations.
$\frac{19}{11}$ 2 ...	Pusa 12 ...	4	0	9	32	19	24	...	...
$\frac{19}{13}$ 1 ...	Punjab 17 ...	4	13	14	18	24	34	3 waterings on— 19th December 1916 ... 14th February 1917 ... 30th March 1917 ...	Good crop in both cases.
$\frac{19}{13}$ 2 ...	Pusa 12 ...	4	13	14	10	24	20	...	...
$\frac{19}{23}$ 1 ...	Punjab 17 ...	4	8	13	0	23	25	3 waterings on— 18th December 1916 ... 24th January 1917 ... 30th March 1917 ...	Good crop in both cases.
$\frac{19}{23}$ 2 ...	Pusa 12 ...	4	8	12	36	23	18	...	...
Average outturn.									
	Panjab 17 ...	55	12	135	30	19	21		
	Pusa 12 ...	55	8	127	12	18	18		

No. 17 did better on the whole; poor tillering and more shedding of grain seems responsible for the low yield in case of Pusa 12. The latter is earlier in ripening, so hails which fell at the ripening time did great damage to the crop. The extent of damage, however, on the crop in heavier lands which ripens a bit later, was comparatively less. The fall was unequally distributed so that the damage was less serious in some plots than in others.

Statement 15.

OUTTURN OF 4 F AMERICAN COTTON GROWN IN SQUARE 26.

No. of square and plot.	No. of sub-plot.	Treatment.	AREA.		ACTUAL OUTTURN.		OUTTURN PER ACRE.		REMARKS.
			anals.	Marlas.	Maunds.	Seers.	Maunds.	Seers.	
26 A 4	1 a	Drilled 3 feet apart on flat, ridged afterwards, top width 2 feet with narrow bottom.	4	0	3	9	6	19	Time taken to irrigate the ridged plots was approximately $\frac{2}{3}$ of that on flat with the same supply of water in the khal.
	1 b	Ditto	4	0	3	10	6	21	
	2 a	Drilled 3 feet apart on flat ...	4	0	2	32	5	24	Ploughing ... 3
	2 b	Ditto	4	0	3	22	7	5	Harrowing ... 7
	3 a	Drilled on flat 3 feet apart, ridged afterwards, flat ridges 2' wide at bottom.	4	0	2	9	4	18	Hoeing ... 7
	3 b	Ditto	4	0	3	28	7	16	Sohagaing ... 11 Watering ... 7
									Date of sowing, 5th and 6th of April 1916.
									Picking began on 12th October 1916 and finished on 19th January 1917.

Statement 15.

RESULTS OF HYDRAULIC EXPERIMENTS WITH FARM SELECTED BROAD LEAF SANGUINEUM COTTON GROWN IN SQUARE 10, 1916-17.

No. of square and plot.	No. of sub-plot.	Treatment.	AREA.		ACTUAL OUTTURN.		OUTTURN PER ACRE.		Irrigation in inches before sowing.	Irrigation in inches after sowing.	REMARKS.
			Kanals.	Marlas.	Maunds.	Seers.	Maunds.	Seers.			
10 B 1 b	1	Ordinary cultivation with 8 kharis per acre.	2	0	2	5	8	22	3.62	13.44	Owing to presence of reh the plot was poor by 2 %.
	2		2	0	2	7	8	28	3.51	13.68	
	3	Cotton drilled in lines 2'-4" apart.	2	0	2	13	9	13	3.51	13.26	Owing to presence of reh the plot was poor by 2.4%. Space uncovered 5.9%.
	4		2	0	2	20	10	0	3.79	13.66	
10 B 2 b	1	Ordinary cultivation with 8 kharis per acre.	2	0	1	18	5	34	3.98	15.18	Ditto 8.8%.
	2		2	0	1	17	5	31	3.23	15.23	
	3	Cotton sown broadcast	2	0	2	8	8	34	3.7	14.72	Ditto 1.3%.
	4		2	10	2	1	8	5	3.7	14.94	

Ploughing ... 3

Harrowing ... 4

Sohagaing ... 5

Bullock hoeings in B, 1 b. = 6 Hoeing with Desi plough in B 2 b = 1.

Date of sowing, 8th May 1916. Watering to { B 1 b = 5.
B 2 b = 6.

Picking began on 10th October 1916 and finished on 5th February 1917.

Statement 17.

RESULTS OF HYDRAULIC EXPERIMENTS WITH WHEAT GROWN IN SQUARE 10, RABI 1916-17.

No. of square and plot.	No. of sub-plot.	Treatment.	Area.		OUTTURN PER ACRE								ACTUAL OUTTURN.				Irrigation in inches before sowing.	Irrigation in inches after sowing.	REMARKS.
			Kanas.	Mounds.	Grain.		Bhusa.		Mounds.	Seers.	Mounds.	Seers.	Grain.	Bhusa.	Mounds.	Seers.			
					Mounds.	Seers.	Mounds.	Seers.											
10 B 1 a	1	2 Kiaris, ordinary cultivation, surface harrowing and three waterings.	2	4	12	9	25	17	10	38	22	2.49	7.22	Lodging 90 per cent., due to presence of reh : plot was poor by 3 per cent.					
	2	2 Kiaris, ordinary cultivation, surface harrowing and two waterings.	2	5	14	13	4	21	18	52	18	2.57	5.36	Due to presence of reh : plot was poor by 1.6 per cent.					
	3	2 Kiaris, ordinary cultivation, surface harrowing and three waterings.	2	6	19	15	20	25	36	62	0	2.57	7.22	Lodging 94 per cent.					
	4	2 Kiaris, ordinary cultivation, surface harrowing and two waterings.	2	6	7	16	8	24	31	64	32	2.57	5.36	Lodging 8 per cent.					
10 B 2 a	1	2 Kiaris, ordinary cultivation, surface harrowing and three waterings.	2	5	1	9	37	20	6	39	29	2.4	7.38	Lodging 90 per cent.					
	2	2 Kiaris, ordinary cultivation, surface harrowing and two waterings.	2	5	2	10	18	20	8	41	34	2.59	5.17	Due to presence of reh : plot was poor by 1.8 per cent.					
	3	2 Kiaris, ordinary cultivation, surface harrowing and three waterings.	2	5	9	10	10	20	36	41	2	2.49	7.38	Lodging 94 per cent., due to presence of reh : plot was poor 6.3 per cent.					
	4	2 Kiaris, ordinary cultivation, surface harrowing and two waterings.	2	5	5	11	6	20	20	44	24	2.4	5.17	Lodging 5 per cent.					

Ploughing ... 5
Harrowing ... 10
Sowing ... 7
Surface harrowings, 4 to plots 1 and 3 and 2 to plots 2 and 4.
Date of sowing, —17th November 1916.
Date of harvesting, —25th and 26th April 1917.

Statement 18.

RESULTS OF BONEMEAL AND GYPSUM TRIALS WITH WHEAT IN TENANTS' AREA, RABI 1916-17.

No. of square and kills.	No. of plot.	Name of crop.	Treatment.	Area.		ACTUAL OUTTURN.				OUTTURN PER ACRE.				REMARKS.
				Kanals.	Marlas.	Grain.		Bhusa.		Grain.		Bhusa.		
						Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
17	1	Wheat, Punjab Type No. 11.	Unmanured	2	4	2	39	7	9	10	32	26	11	2 waterings.
	2		Bonemeal at 6 maunds per acre	2	4	3	15	8	17	12	11	30	25	
	3		Gypsum at 6 maunds per acre	2	4	4	9	8	16	15	14	30	22	
	4		Farmyard manure at 5 tons per acre	2	4	4	10	9	30	15	18	35	18	
17	1		Farmyard manure at 5 tons, and bone-meal, at 6 maunds per acre	2	3	4	34	11	15	18	3	42	13	3 waterings.
	2		Unmanured	2	3	4	36	11	16	18	9	42	16	
	3		Bonemeal at 6 maunds per acre	2	3	4	20	11	4	16	30	41	12	
	4		Gypsum at 6 maunds per acre	2	3	5	4	10	16	18	39	38	28	
17	1		Farmyard manure at 5 tons per acre	2	1	4	34	10	37	18	37	42	25	3 waterings.
	2		Farmyard manure at 5 tons, and bonemeal at 6 maunds per acre	2	1	4	8	10	15	16	15	40	19	
	3		Unmanured	2	1	4	10	8	17	16	23	32	35	
	4		Bonemeal at 6 maunds per acre	2	1	5	15	9	14	20	39	36	19	
17	1		Gypsum at 6 maunds per acre	1	19	6	10	10	3	25	25	41	13	3 waterings.
	2		Frmayard manure at 5 tons per acre	1	19	5	6	9	27	21	5	39	27	
	3		Farmyard manure at 5 tons per acre, and bonemeal at 6 maunds per acre	1	19	5	2	8	8	20	23	33	26	
	4		Unmanured	1	19	4	17	7	28	18	6	31	23	

Outturn per acre.		Maunds.		Seers.	
Unmanured	...	15	...	34	...
Bonemeal	...	16	...	23	...
Gypsum	...	19	...	31	...
Farmyard manure	...	18	...	15	...
Farmyard manure and bonemeal	...	18	...	13	...

Ploughings ... 2.
Harrowing ... 5.
Surface harrowing ... 3.
Date of sowing—28th November 1916.
Date of harvesting—21st to 24th April 1917.

Statement 19.

RESULTS OF HYDRAULIC EXPERIMENTS WITH WHEAT GROWN IN SQUARE 10, RABI 1916-17.

No. of square and plot.	No. of sub-plot.	Treatment.	Area.	ACTUAL OUTPUT.				OUTPUT PER ACRE.				Irrigation in inches before sowing.	Irrigation in inches after sowing.	REMARKS.
				Grain.		Bhusa.		Grain.		Bhusa.				
				Maunder.	Seers.	Maunder.	Seers.	Maunder.	Seers.	Maunder.	Seers.			
10	1	Ordinary cultivation with 16 kharis per acre.	2	6	5	11	14	24	23	45	18	2.62	7.56	Lodging 95 per cent.
	2	Ordinary cultivation with 8 kharis per acre.	2	5	20	9	16	22	3	37	24	2.72	6.66	Lodging 30 per cent. owing to the presence of reh plot was poor by 9 per cent.
	3	Ordinary cultivation with 4 kharis per acre.	2	5	0	9	30	20	1	39	0	2.66	7.76	Lodging 42 per cent. Owing to the presence of reh plot was poor by 10.8 per cent.
	4	Ordinary cultivation with 8 kharis per acre.	2	5	0	12	7	20	0	43	28	2.4	6.66	Lodging 10 per cent.
10	1	Ordinary cultivation with 16 kharis per acre.	2	6	15	13	2	25	23	52	5	2.73	7.5	Lodging 98 per cent.
	2	Ordinary cultivation with 8 kharis per acre.	2	5	1	14	38	20	7	59	33	2.83	7.6	Lodging 45 per cent.
	3	Ordinary cultivation with 4 kharis per acre.	2	5	18	12	36	21	33	51	24	2.38	6.87	Lodging 20 per cent. Owing to the presence of reh the plot was poor by 1.3 per cent.
	4	Ordinary cultivation with 8 kharis per acre.	2	3	35	10	29	15	22	42	38	2.61	6.77	Rust present in all plots.

Ploughing ... 5

Harrowing ... 10

Sohagaing ... 7

Surface harrowing ... 4

Waterings ... 3

Date of sowing—17th November 1916.

Date of harvesting—26th and 27th April 1917.

Statement 20.

RESULTS OF HYDRAULIC EXPERIMENTS WITH TORIA GROWN IN SQUARE 10, 1916.

No. of square and plot.	No. of sub-plot.	Treatment.	AREA.	ACTUAL OUTTURN.				OUTTURN PER ACRE.				Irrigation in inches before sowing.	Irrigation in inches after sowing.	REMARKS.
				Grain.		Straw.		Grain.		Straw.				
				Mounds.	Seers.	Mounds.	Seers.	Mounds.	Seers.	Mounds.	Seers.			
10	A 1 a	1	2	4	3	9	6	16	14	36	25	2.47	6.72	Lodging 5 per cent.
		2	2	4	11	10	20	17	6	42	2	2.54	7.49	Do. 10 per cent.
		3	2	5	1	11	1	20	6	44	6	2.54	8.14	Do. 55 per cent.
		4	2	4	38	12	29	19	32	50	38	2.25	6.92	Do. 80 per cent.
10	A 2 a	1	2	3	28	8	39	14	33	35	38	2.81	6.62	Do. 6 per cent.
		2	2	3	21	8	9	14	4	32	36	2.81	7.01	Do. 12 per cent.
		3	2	4	12	8	21	17	9	34	6	2.81	7.26	Do. 25 per cent.
		4	2	5	6	9	19	20	25	37	38	2.81	6.77	Do. 30 per cent.

Ploughing ... 3
Harrowing ... 6
Sowing ... 3
Watering ... 3
Date of sowing,--12th September 1916.
Date of harvesting,--28th to 31st January 1917.

Statement 21.

RESULTS OF HYDRAULIC EXPERIMENTS WITH TORIA GROWN IN SQUARE 10, 1916.

No. of square and plot.	No. of sub-plot.	Treatment.	AREA.	ACTUAL OUTTURN.				OUTTURN PER ACRE.				Irrigation in inches before sowing.	Irrigation in inches after sowing.	REMARKS.
				Grain.		Straw.		Grain.		Straw.				
			Kanals.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.			
10 A15	1	Ordinary cultivation with 16 kiaris per acre.	2	3	14	6	14	13	18	25	18	2'61	9'88	
	2	Ordinary cultivation with 8 kiaris per acre.	2	3	5	6	21	12	22	26	6	2'61	9'4	Owing to reh plot was poor by 12 per cent.
	3	Ordinary cultivation with 4 kiaris per acre.	2	4	16	7	2	17	24	28	10	2'98	9'51	Owing to the presence of reh plot was poor by 8 per cent.
	4	Ordinary cultivation with 8 kiaris per acre.	2	3	31	6	8	15	4	24	34	2'25	9'11	
10 A25	1	Ordinary cultivation with 16 kiaris per acre.	2	3	7	6	33	12	30	27	12	2'77	9'17	Owing to the presence of reh the plot was poor by 4'6 per cent.
	2	Ordinary cultivation with 8 kiaris per acre.	2	3	19	7	13	13	36	29	12	2'31	8'56	Owing to the presence of reh the plot was poor by 6 per cent.
	3	Ordinary cultivation with 4 kiaris per acre.	2	4	0	7	27	16	1	30	28	2'72	8'85	Owing to the presence of reh the plot was poor by 4'7 per cent.
	4	Ordinary cultivation with 8 kiaris per acre.	2	3	19	6	29	13	36	26	36	2'14	8'18	

Ploughing

...

...

...

3

Harrowing

...

...

...

6

Sohaging

...

...

...

3

Watering

...

...

...

4

Date of sowing—12th and 13th September 1916.

Date of harvesting—28th January to 1st February 1917.

Statement 22.

RESULTS OF HYDRAULIC EXPERIMENTS WITH FARM SELECTED BROADLEAF SANGUINEUM COTTON GROWN IN SQUARE 10, KHARIF 1916.

No. of square and plot.	No. of sub-plot.	Treatment.	AREA.	ACTUAL OUTTURN.		OUTTURN PER ACRE.		Irrigation in inches before sowing.	Irrigation in inches after sowing.		REMARKS.
			Kanals.	Maunds.	Seers.	Maunds.	Seers.				
10 C15	1	Ordinary cultivation with 16 kiaris per acre.	2	1	35	7	20	3.96	14.58	2 per cent. poor.	Ploughing ... 2 Harrowing ... 3 Sohaging ... 3 Hoing ... 6 Watering ... 5 Date of sowing—14th April 1916. Picking began on 10th October 1916 and finished on 5th February 1917.
	2	Ordinary cultivation with 8 kiaris per acre.	2	1	31	7	7	4.16	15.48	1.3 per cent. poor.	
	3	Ordinary cultivation with 4 kiaris per acre.	2	2	2	8	10	4.85	14.43		
	4	Ordinary cultivation with 8 kiaris per acre.	2	1	34	7	17	4.76	14.63		
10 C25	1	Ordinary cultivation with 16 kiaris per acre.	2	2	5	8	22	3.96	15.77		
	2	Ordinary cultivation with 8 kiaris per acre.	2	2	1	8	4	3.96	13.32		
	3	Ordinary cultivation with 4 kiaris per acre.	2	2	5	8	20	5.05	15.28		
	4	Ordinary cultivation with 8 kiaris per acre.	2	1	37	7	28	3.96	13.52	0.5 per cent. poor.	

Statement 23.

EFFECT OF CALCIUM NITRATE ON WHEAT GROWN IN SQUARE 7, RABI 1916-17.

No. of square and kills.	MANURED.				UNMANURED.				INCREASE PER ACRE.				Expenditure on calcium nitrate at Rs. 14-5-0 per cwt.	Profit.	Deficit.	REMARKS.			
	OUTTURN PER ACRE.		OUTTURN PER ACRE.		OUTTURN PER ACRE.		OUTTURN PER ACRE.		Grain.		Bhusa.								
	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.							
No. of plot.	Quantity of calcium nitrate per acre.	Maunds.	Seers.	Maunds.	Seers.	No. of square and kills.	No. of plot.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.				
2	168 lbs.	13	32	22	18	7	1	13	14	19	38	0	18	2	20	Rs. A. P. Grain ... 1 11 0 Bhusa ... 1 4 0 Total ... 2 15 0	Rs. A. P. 21 7 6	Rs. A. P. 18 8 6	Plot 2 is 6-7 per cent. poor. Plot 1 is 15 per cent. poor.
1	112 lbs.	13	28	23	14	7	2	8	36	16	14	4	82	7	0	Rs. A. P. Grain ... 18 0 0 Bhusa ... 3 8 0 Total ... 21 8 0	Rs. A. P. 14 5 0	Rs. A. P. 7 3 0	Plot 2 is 13-6 per cent. poor. Whole crop lodged very badly.

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Statement 24.

EFFECT OF GREEN MANURING ON WHEAT GROWN IN AREA A, SQUARE 2, RABI 1916-17.

No. of square and plot.	No. of sub-plot.	Treatment.	AREA.		ACTUAL OUTTURN.				OUTTURN PER ACRE.				REMARKS.
					Grain.		Bhusa.		Grain.		Bhusa.		
			Kanals.	Marlas.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
2 A.	11	San buried in, on 14th Sep- tember 1916.	4	8½	5	19	8	29	9	37	15	32	San crop, 5 feet to 6 feet high.
	12	Moth ...	4	8½	5	34	10	35	10	24	19	28	Moth, 6 inches to 7 inches high.
	13	Mash ...	4	3½	7	19	13	21	14	14	26	0	Mash, 13 inches to 18 inches high.
	14	San ...	4	3½	5	25	10	29	10	32	20	24	San, 5 feet 6 inches to 6 feet high.
	15	San ...	4	5½	6	29	13	13	12	24	24	38	San, 6½ feet to 7 feet high.
	16	Mung ...	4	5½	7	29	14	25	14	19	27	16	Mung, 13 inches high.
	17	San ...	4	4½	4	37	9	38	9	15	18	35	San, 6 feet 7 inches high.
	18	Indigo ...	4	4½	6	8	11	22	11	30	21	37	Indigo, 2 feet high.
	19	San ...	2	0	1	8	1	36	4	32	7	24	San, 4 feet 8 inches to 6 feet 2 inches high.
	20	Guara ...	2	0	3	19	6	5	13	36	24	20	Guara, 3 feet to 3 feet 6 inches high.

Ploughing	...	...	...	...	1
Harrowing	...	...	...	...	2
Sohaging	...	...	...	...	5
Surface harrowing	...	...	...	...	2
Watering	...	...	...	...	3

Date of sowing—20th November 1916.

Date of harvesting—1st May 1917.

Statement 25.

RESIDUAL EFFECT OF COMPARATIVE GREEN MANURING ON WHEAT GROWN IN AREA A, SQUARE 2, RABI 1916-17.

No. of square and plot.	No. of sub-plot.	Treatment.	AREA.		ACTUAL OUTTURN.				OUTTURN PER ACRE.				REMARKS.
					Grain.		Bhusa.		Grain.		Bhusa.		
			Kanals.	Marlas.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
2 A.	1	Residue of san buried in, on 22nd September 1915.	2	0	2	9	3	23	8	36	14	12	Ploughing 3
	2	Guara Ditto ...	2	0	3	27	6	18	14	28	25	32	Harrowing 11
	3	San Ditto ...	3	16	4	9	6	10	8	35	13	6	Sohaging 4
	4	Indigo Ditto ...	3	16	5	27	13	14	11	38	28	4	Watering 3
	5	San Ditto ...	3	17½	4	26	9	14	9	25	19	4	Surface harrowing ... 3
	6	Mung Ditto ...	3	17½	6	11	12	26	13	0	26	8	Date of sowing—16th Novem- ber 1916.
	7	San Ditto ...	3	15½	3	37	6	17	8	13	13	25	Date of harvesting—28th April to 1st May 1917.
	8	Mash Ditto ...	3	15½	3	21	5	36	7	19	12	21	
	9	San Ditto ...	3	19½	6	8	8	12	12	17	16	26	
	10	Moth Ditto ...	3	19½	5	39	11	16	11	39	22	34	

Statement 26.

HOT WEATHER CULTIVATION VERSUS RAIN PLOUGHING IN TENANTS' AREA, RABI 1916-17.

HOT WEATHER PLOUGHING.

No. of square.	No. of plot.	Type of wheat.	AREA.		ACTUAL OUTTURN.				OUTTURN PER ACRE.				REMARKS.
					Grain.		Bhusa.		Grain.		Bhusa.		
			Kanals.	Marlas.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
6	7	Punjab 11	9	2	17	7	36	0	15	4	31	26	Ploughed on 28th April 1916.
6	9	Ditto	8	17	9	30	16	0	8	32	14	18	Ploughed on 2nd May 1916.
6	11	Ditto	7	2	10	6	16	28	11	17	18	32	Ploughed on 29th April 1916.
6	13	Ditto	8	1	10	8	17	32	10	0	17	27	Ploughed on 3rd May 1916.

RAIN PLOUGHING

No. of square.	No. of plot.	Type of wheat.	AREA.		ACTUAL OUTTURN.				OUTTURN PER ACRE.				REMARKS.
					Grain.		Bhusa.		Grain.		Bhusa.		
			Kanals.	Marlas.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
6.	8	Punjab 11	8	12	11	9	18	24	10	18	17	12	Ploughed on 14th August 1916.
6	10	Ditto	7	11	8	17	16	12	8	37	17	10	Ploughed on 13th August 1916.
6	12	Ditto	8	7	13	0	20	31	12	18	19	36	Ploughed on 15th August 1916.
6	14	Ditto	8	1	11	23	21	7	11	20	21	1	Ploughed on 12th August 1916.

Ploughings 2
 Harrowings 4
 Waterings 2
 Bar harrowing 1

Date of sowing—20th to 23rd November 1916.

Date of harvesting—25th-26th April 1917.

Dates of rainfall:—

8th May	...	...	...	18 inches.
24th June	...	...	...	4 "
9th July	...	...	...	54 "
13th July	...	...	...	36 "
18th July	...	...	...	11 "
25th July	...	...	...	11 "
2nd August	...	...	...	29 "
4th August	...	...	...	19 "
5th August	...	...	...	35 "
10th August	...	...	...	202 "
13th August	...	...	...	81 "

Statement 27.

RESULTS OF MANURIAL AND VARIETY EXPERIMENTS WITH SUGARCANE IN TENANTS' AREA, IN SQUARE 13,
YEAR 1916-17.

No. of square and plot.	No. of sub-plot.	Variety of cane.	Treatment.	AREA.		WEIGHT OF GREEN TOPS.		WEIGHT OF CANES.		WEIGHT OF JUICE.		WEIGHT OF GUR.		AVERAGE YIELD OF GUR PER ACRE.		REMARKS.
				Kowals.	Marlas.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
13 15	1	Katha	Farmyard manure at 15 tons per acre.	0	19½	24	18	47	3	24	15	4	4	34	26½	There is an increase of 9½ seers in yield by the application of Mohwa cake in addition to farmyard manure. The extra yield obtained does not cover the cost of manure applied.
	6	Do	Ditto	0	19½	23	28	57	23	25	38	4	14			
	5	Do.	Farmyard manure at 15 tons per acre + Mohwa cake at 15 maunds per acre.	0	19½	21	38	43	22	24	1	4	0	34	35	
	2	Do.		0	14	16	13	34	0	19	31	3	12			
	4	Kansar	Farmyard manure at 15 tons per acre.	0	19½	20	5	46	21	26	5	4	30	39	28	
	7	Do.		0	13½	15	8	37	32	22	10	3	18			
	3	Do.	Farmyard manure at 15 tons per acre + Mohwa cake at 15 maunds per acre.	0	11½	13	13	36	27	21	8	3	18	23	15	
	8	Do.		0	19½	21	39	49	3	28	0	4	2			

Statement 28.

RESULTS OF MANURIAL EXPERIMENTS WITH SUGARCANE IN TENANTS' AREA IN 1916-17.

No. of square and plot.	No. of sub-plot.	Variety of cane.	Treatment.	AREA.		WEIGHT OF TOPS.		WEIGHT OF CANES.		WEIGHT OF JUICE.		WEIGHT OF GUR.		AVERAGE OUTTURN OF GUR PER ACRE.		REMARKS.	
				Kanals.	Marlas.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.		
5 11	1	Katha	...	Farmyard manure at 15 tons per acre and mohwa cake at 15 maunds per acre.	1	14	33	29	69	29	26	12	6	25	32	24	The cost of mohwa cake delivered at Lyallpur last season was Re. 0-11-0 per maund, or Rs. 10-5-0 for 15 maunds applied per acre. There is an increase of 24 seers in the outturn of gur, the price of which at Rs. 5 per maund comes to Rs. 3. There is thus a loss of Rs. 7-5-0 per acre by the application of this manure.
	2	Do.	...		1	19	43	6	84	31	44	34	3	10			
	3	Do.	...	Farmyard manure at 15 tons per acre.	1	19	37	29	81	27	45	26	3	6	32	0	
	4	Do.	...		1	19	40	6	73	0	41	12	7	18			

Statement 29.

RESULTS OF BONEMEAL AND GYPSUM TRIALS WITH TORIA IN TENANTS' AREA, 1916-17.

No. of square and killa.	No. of plot.	Treatment.	AREA.		ACTUAL OUTTURN.				OUTTURN PER ACRE.				REMARKS.	
			Kanals.	Marlas.	Grain.		Straw.		Grain.		Straw.			
					Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.		
12 3	1	Unmanured ...	1	9	2	24	5	20	14	13	30	13	Ploughing ...	2
	2	Bonemeal at 4 maunds per acre ...	1	9	1	37	4	20	10	25	24	33	Harrowing ...	2
	3	Gypsum at 6 maunds per acre ...	1	9	1	25	4	4	8	38	22	24	Watering ...	3
	4	Farmyard manure at 5 tons per acre	1	7½	1	30	4	4	10	7	23	34	Date of sowing,—11th Sep- tember 1916.	
	5	Farmyard manure at 5 tons per acre and bonemeal at 4 maunds per acre.	1	9	2	0	4	29	11	1	26	2	Date of harvesting,—20th January to 2nd February 1917.	
12 3	1	Unmanured ...	1	8	2	36	6	17	16	23	36	28		
	2	Bonemeal at 6 maunds per acre ...	1	10	3	8	7	4	17	2	37	34		
	3	Gypsum at 6 maunds per acre ...	1	10	2	30	6	33	14	26	36	16		
	4	Farmyard manure at 5 tons per acre	1	10	2	29	6	15	14	21	34	0		
	5	Farmyard manure at 5 tons per acre and bonemeal at 6 maunds per acre.	1	10	2	2	7	2	16	10	37	24		
12 4	1	Unmanured ...	1	11	2	21	5	36	13	1	30	18		
	2	Bonemeal at 6 maunds per acre ...	1	11	2	24	6	0	13	16	30	39		
	3	Gypsum at 6 maunds per acre ...	1	11	3	11	7	18	16	36	38	18		
	4	Farmyard manure at 5 tons per acre and gypsum at 6 maunds per acre.	1	11	3	7	7	11	16	15	37	22		
	5	Farmyard manure at 5 tons per acre and bonemeal at 6 maunds per acre.	1	11	3	8	6	33	16	20	35	36		
12 5	1	Farm yardmanure at 5 tons per acre	1	8	2	14	6	8	13	17	29	27		
	2	Unmanured ...	0	5	0	16	0	26	12	32	20	32		

Statement 30.

RESIDUAL EFFECT OF BONEMEAL AND GYPSUM ON TORIA IN TENANTS' AREA, KHARIF 1916.

No. of square and killa.	No. of plot.	Treatment.	AREA.		ACTUAL OUTTURN.				OUTTURN PER ACRE.				REMARKS.
			Kanals.	Marlas.	Grain.		Bhusa.		Grain.		Bhusa.		
					Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
16 8	1	Unmanured	1	17	3	1	5	36	13	3	25	20	Ploughing ... 1 Harrowing ... 3 Waterings ... 2 Date of sowing.—13th Sep- tember 1916. Date of harvesting.—20th to 23rd January 1917.
	2	Residue of bonemeal at 4 maunds per acre.	1	17	3	2	5	33	13	7	25	29	
	3	Residue of gypsum at 6 maunds per acre.	1	17	3	7	6	5	13	29	26	19	
	4	Unmanured	1	17	3	14	6	30	14	19	29	7	
	5	Residue of bonemeal at 4 maunds per acre.	1	17	3	17	7	21	14	32	32	21	
16 13	1	Residue of gypsum at 6 maunds per acre.	1	13	2	36	5	26	14	2	28	24	
	2	Unmanured	1	13	2	23	5	45	12	19	26	2	
	3	Residue of bonemeal at 4 maunds per acre.	1	13	2	27	5	26	12	38	27	15	
	4	Residue of gypsum at 6 maunds per acre.	1	12	2	37	5	37	14	25	29	25	
	5	Unmanured	1	13	3	2	6	8	14	31	30	2	

Statement 31.

RESULTS OF RESIDUAL EFFECT OF BONE MEAL AND GYPSUM ON COTTON GROWN IN THE TENANT'S AREA, KHARIF 1916.

No. of square and killa.	No. of plot.	Name of variety.	Treatment.	AREA.		ACTUAL OUTTURN.		OUTTURN PER ACRE.		REMARKS.
				Kanals.	Marlas.	Maunds.	Seers.	Maunds.	Seers.	
13 — 10	1	4 F American Cotton.	Unmanured ...	2	3	2	28½	10	3	Ploughing ... 2
	2		Residue of bonemeal at 4 maunds per acre.	2	3	1	39½	7	14	Harrowing ... 3
	3		Residue of gypsum at 6 maunds per acre.	2	3	2	7½	7	17	Sohagimg ... 2
	4		Unmanured ...	2	3	2	13½	8	27	Hoeing and weeding ... 6
13 — 11	1		Residue of bonemeal at 4 maunds per acre.	1	19	2	12½	9	18	*Watering ... 7
	2		Residue of gypsum at 6 maunds per acre.	1	19	2	9½	9	5	Date of sowing 13th April 1916.
	3		Unmanured ...	1	19	2	16½	9	37	Picking began on 19th October 1916 and finished on 17th January 1917.
	4		Residue of bonemeal at 4 maunds per acre.	1	19	2	22½	10	22	
13 — 20	1		Residue of gypsum at 6 maunds per acre.	2	3	2	12½	8	23	
	2		Unmanured ...	2	3	2	23½	9	25	

*Dates of watering :—

2nd May 1916.
4th June 1916.
28th June 1916.
20th July 1916.
14th September 1916.
27th September 1916.
12th October 1916.

Statement 32 (a).—

OUTTURNS OF AMERICAN COTTON VARIETIES TESTED ON TENANTS' AREA, KHARIF 1916.

Standard 4 F.

No. of square and plot.	YIELD PER ACRE.				No. of square and plot.	YIELD PER ACRE.			
	4 F.		280 F.			4 F.		275 F.	
	Maunds.	Seers.	Maunds.	Seers.		Maunds.	Seers.	Maunds.	Seers.
$\frac{5}{20}$	12	4	9	31	$\frac{3}{17}$	18	15	18	2
$\frac{5}{6}$	9	26	10	15	$\frac{6}{4}$	17	8	17	8
$\frac{7}{6}$	23	7	21	5	$\frac{7}{12}$	10	33	12	18
$\frac{16}{12}$	18	24	14	11	$\frac{12}{23}$	11	27	10	25
$\frac{17}{12}$	7	35	7	27	$\frac{19}{12}$	7	35	7	18
$\frac{19}{9}$	9	33	10	27		6	20	5	24
	17	6	14	7		7	17	5	25
	19	13	16	7		8	6	6	19
	9	17	9	37		15	25	15	5
	10	3	13	4		15	5	17	11
	10	20	11	16		...	...	...	...
	13	9	13	7		...	...	...	...

Name of variety.	AREA.		OUTTURN PER ACRE.		Name of variety.	AREA.		OUTTURN PER ACRE.	
	Kanals.	Marlas.	Maunds.	Seers.		Kanals.	Marlas.	Maunds.	Seers.
4 F	...	...	23	18	4 F	...	...	20	14
280 F	...	...	24	0	275 F	...	...	20	16

Statement 32 b (i).

OUTTURNS OF DESI COTTON OF VARIETIES TESTED ON TENANT'S AREA, KHARIF 1916. STANDARD ROSEA NO. 87.

No. of square and plot.	YIELD PER ACRE.				No. of square and plot.	YIELD PER ACRE.			
	G. Rosea No. 87.		Mollisoni No. 24.			G. Rosea No. 87.		Indicum 135 A.	
	Maunds.	Seers.	Maunds.	Seers.		Maunds.	Seers.	Maunds.	Seers.
$\frac{13}{18}$	9	23	9	30	$\frac{5}{21}$	11	11	9	23
	8	2	9	25		12	17	10	1
$\frac{11}{9}$	8	29	11	22	$\frac{16}{17}$	17	14	14	34
	11	39	12	11		17	19	15	10
$\frac{13}{9}$	5	21	8	6	$\frac{16}{14}$	14	17	13	6
	9	23	11	24		13	1	11	12
$\frac{19}{18}$	20	10	22	23	$\frac{19}{10}$	14	16	12	10
	22	19	23	16	$\frac{20}{5}$	15	6	13	11
						14	24	12	...

Name of variety.	AREA		OUTTURN PER ACRE.		Name of variety.	AREA.		OUTTURN PER ACRE.	
	Kanals.	Marlas.	Maunds.	Seers.		Kanals.	Marlas.	Maunds.	Seers.
Rosea No. 87	17	1	12	2	Rosa No. 87	18	14	14	19
Mollisoni No. 24	16	18	13	29	Indicum No. 135-A	18	11	12	19

Statement 32 b (ii).

OUTTURNS OF DESI COTTON VARIETIES TESTED ON TENANT'S AREA, KHARIF 1916.
STANDARD FARM SELECTED BROAD-LEAVED SANGUINEUM. STANDARD ROSEA NO. 87.

No. of square and plot.	YIELD PER ACRE.				No. of square and plot.	YIELD PER ACRE.			
	Farm selected broad leaved sanguineum.		Sanguineum No. 20 A.			Rosea No. 87.		Neglectum No. 109.	
	Maunds.	Seers.	Maunds.	Seers.		Maunds.	Seers.	Maunds.	Seers.
$\frac{6}{5}$	17	6	15	14	$\frac{6}{18}$	12	39	13	13
	17	3	16	34		12	32	13	32
$\frac{7}{15}$	16	1	16	8	$\frac{17}{20}$	18	36	17	17
	16	11	15	30		15	24	17	0
$\frac{16}{9}$	4	0	4	3					
	4	35	5	15					

Name of variety.	AREA.		OUTTURN PER ACRE.		Name of variety.	AREA.		OUTTURN PER ACRE.	
	Kanals.	Marlas.	Maunds.	Seers.		Kanals.	Marlas.	Maunds.	Seers.
Farm selected broad leaved sanguineum.	11	18	12	13	Rosea No. 87	8	12	15	5
Sanguineum No. 20 A	11	16	12	1	Neglectum No. 109.	8	12	15	17

Statement 33 (a).

RESULTS OF VARIETY AND SPACING EXPERIMENTS WITH MANGEL-WURZEL, RABI 1916-17.

No. of square and plot.	No. of sub-plot.	Name of variety.	Distance between the rows.	Area in acres.	ACTUAL OUTTURN.				OUTTURN, PER ACRE.				REMARKS.
					Roots.		Leaves.		Roots.		Leaves.		
					Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
27 A 2	1	Mammoth, long red	Ridges 24" apart	$\frac{7}{40}$	124	32	18	12	713	5	104	34	Farmyard manure at 15 tons per acre.
	2	Golden Tankard ...	" 24" "	$\frac{7}{40}$	66	24	12	13	380	23	70	17	
	3	Ditto ...	" 30" "	$\frac{7}{40}$	64	30	7	32	370	0	44	28	
	4	Mammoth long red	" 36" "	$\frac{7}{40}$	117	25	21	17	672	5	122	17	
	5	Golden Tankard ...	" 36" "	$\frac{7}{40}$	88	16	17	10	505	5	98	28	

Ploughing 6
 Harrowing 17
 Sohaging 11
 Hoeing and weeding 5
 Earthing 2

Date of sowing—27th October 1917.

Date of harvesting—{ Mammoth, long red—25th-30th April 1917.

{ Golden Tankard—1st to 16th May 1917.

Waterings—(9) on 18th November 1916, 12th December 1916, 30th December 1916, 30th January 1917, 28th February 1917, 23rd March 1917, 1st April 1917, 22nd April 1917, and 1st May 1917.

Statement 33 (b).

SHOWING OUTTURN OF MANGEL-WURZEL GROWN IN RABI 1916-17.

No. of square and plot.	No. of sub-plot.	Name of variety.	Distance between the ridges.	AREA. Kana's.	ACTUAL OUTTURN.				OUTTURN PER ACRE.				REMARKS.
					Roots.		Leaves.		Roots.		Leaves.		
					Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
3 A 3	1	Golden Tankard ...	30"	1	26	18	6	2	211	24	48	16	Roots began to decay after 1st April 1917.
	2	Mammoth long red	30"	1	41	36	8	24	335	8	68	32	
	3	Golden Tankard ...	30"	1	26	29	4	0	213	32	32	0	
	4	Mammoth long red	30"	1	62	4	5	24	496	32	44	32	

Ploughing 4
 Harrowing 4
 Sohaging 5
 Watering 6
 Ridging, hoeing and weeding 5

Date of sowing—10th and 11th October 1916.

Date of harvesting—{ Golden Tankard—4th to 10th April 1917.

{ Mammoth long red—3rd to 7th May 1917.

APPENDIX VII.

Report of the Officiating Deputy Director of Agriculture on the
Gurdaspur Farm.

Introductory.—I was in charge of this farm throughout the year under report.

Brief history and objects of the farm.—1. The farm—area 104 acres, of which 89 are under cultivation—was started in 1910 with the primary object of improving the sugarcane crop of the district: as a “side show” varietal tests with wheats were started on the barani area. Varieties of canes, exotic and indigenous, thick and thin, were collected from all over India and varietal tests were started. This work is still in progress: out of 40 odd varieties with which we started in 1910, 12 only now remain, the others having been discarded. Experiments are also in progress with artificial manures on cane. These were started in conjunction with the late Mr. Barnes, Agricultural Chemist, in collaboration with whom a survey of the cane varieties of the district was carried out in 1911-12. But the results obtained so far, and the analyses done by the Agricultural Chemist, show that Gurdaspur is not a very suitable place for cane: this work, therefore, will probably be transferred to a more suitable locality in the south east of the province.

2. The wheat work has gradually developed, and is now more important than anything else. Much progress has been made with varietal, manurial, and cultivation tests with this crop. The present area of this farm is insufficient for varietal tests of the many varieties of wheats offering: another 50 acres of land are shortly to be added to the farm, and will be utilized for this purpose. Work is also on progress on crops as maize, mash, groundnuts, and fodders. Experiments are also made with improved agricultural implements, to judge of their suitability to these Central Punjab districts. The farm is also very largely used as a seed supplying agency by the zamindars of the surrounding districts: it also provides new implements and Meston ploughs, and parts, are sold at it.

Season (statement 1).—The total rainfall during the year under report (July 1st, 1916 to June 30th, 1917) was 34·72" as compared with 16·70" in the preceding year. This was almost the normal (which is 34·9") rainfall of the district, but it was badly distributed. There was a very good monsoon, which was beneficial to the kharif crops, but much of the monsoon rain was excessive and not wanted. The rain stopped early: the last good shower fell on the September 16th. This helped the preparation of seed beds for rabi crops. After this the season was practically dry till April: in which month there fell seven inches of rain. The farm crops had all been cut before the rain though much of the wheat in the district was still standing. It spoiled both the quality and quantity of the produce; beardless wheats suffered most.

The growing season of the rabi crops was particularly suited to test our methods of conservation of moisture. It was unprecedentedly dry: it was, indeed, the driest winter we have had in the recent past: yet the results on the farm were very satisfactory. This was due to (1) deep cultivation and the keeping of the soil open to receive any rain that fell: (2) the conservation of moisture by constant harrowing and keeping a mulch on the surface to avoid evaporation, and (3) clean cultivation, by eradicating weeds.

The frosts in winter were severe and continual, and had their usual effect on the sugarcane crop, the produce decreasing in quality.

Crop pests.—There was no serious crop pest on the farm. Though the season was dry, some of the irrigated wheats were badly rusted. Smut was also noticed on Pusa 4, Pusa 12 and Punjab 8 A wheats.

Rotation, etc.—The farm is divided almost equally into well irrigated (chahi) and un-irrigated (barani) areas. For rotations on these areas former reports should be consulted.

The chahi area is devoted mainly to experiments with sugarcane and wheat varieties. Maize varietal trials were also started on this area during the year under report; as also were two new series of experiments with superphosphate and bone meal in conjunction with bulky organic manures to ascertain if it will pay to apply them in this manner: repeated trials on this farm show generally that phosphates alone do not pay. They increase the outturn of the crop to which they are applied, but financially they are a loss, as the cost of the manure exceeds the value of the extra produce.

Details of these experiments are given later.

Barani area.—Wheat is the chief crop under investigation on this area. Experiments are being carried on to find (1) the type of wheat that will yield best on barani soils, (2) the manure or manures most suitable for barani wheat lands, and (3) the methods of cultivation that will best increase the fertility and the moisture capacity of barani soils and take the fullest advantage of the slightest rainfall.

Groundnut is also being tried on this area, and varietal trials have been started. Mash (phaseolus mungo), til and other minor crops come in only to complete the rotation.

A new series of experiments with phosphates and an artificial nitrogenous manure was also started on the barani area this year. Bone meal and superphosphate are being tried in conjunction with ammonium sulphate. Details are given later.

Crops—Kharif.—Sugarcane (statement 2).—All chahi.

Besides local Dhau, there were 14 other varieties grown on the farm; two of them have been discarded and 12 kept on. The crop suffered slightly through drought in the end of June, and continued frosts in winter also had a bad effect on the quality of the produce. The season was otherwise favourable for the crop, and the outturns are good. Amongst the new exotic canes J 33 and J 105 tried on a very small scale this year did well, and are being given further trials on a large area. They have also been given out in the Karnal district for tests under zamindari conditions: it is expected that these canes will do well in that district.

Among the United Provinces canes obtained in 1915 Yuba has given very promising results, and is now being grown on a large scale for further tests.

For want of space the manurial experiments with artificial fertilizers started last year were not repeated this year, nor will there be any done next year (1917-18), as we cannot afford to put more than one field under these experiments with cane. They will be repeated in 1918-19, as, following our rotation, canes will be planted in the same field every fourth year.

Maize (statement 3).—Varietal trials (all chahi) were started this year. About seven varieties in all were tested. The results show that the local type has done best in almost all cases, though a type known as "Sargodha", obtained from a village in the Jhelum colony has also done well. It is a white grained variety. The trials will be continued this year.

Cotton.—Three varieties of cotton, Indicum, Sanguineum, and American, are being grown, all chahi, on very small plots for the environment tests of the Economic Botanist. American was badly attacked by cotton leaf roller and was cut: a few plants were however preserved for next year's seed. The results in other cases are:—

<i>Variety.</i>	<i>Outturn per acre.</i>
(1) Indicum	321 lbs.
(2) Sanguineum	262 lbs.

Mash—Only comes in barani rotation. There are no experiments with this crop. It is a legume and is therefore grown preferably to other kharif crops in the general barani rotation.

Rabi—Wheat is the main crop in the rabi, though fodders, as lucerne, shaftal, and berseem, are also being tried.

The ideas underlying the experimental work with barani wheats have already been explained. On the chahi area varietal, and to a less extent manurial, tests are being carried out.

The following work was done on wheat during this year:—

I.—*Comparative varietal tests (statement 4).—Punjab 8 A, 8 B, 17 and 11 were tested with Pusa 12 as standard (chahi area).*

Pusa 12, Punjab 8 A, 8 B, 17 B and 20 C were tested with Punjab 14 as standard (barani area).

Punjab 14 and Pusa 12 were tested *inter se* (barani area): see statement No. 8.

Wheats 8 A, 8 B, 17 B and 20 C are the Economic Botanist's selections.

II.—*Cultivation (statement 8).—*

(a) Hot weather cultivation <i>versus</i> ordinary cultivation	...	...	} all on barani area.
(b) Sabul plough with country plough	...	...	
(c) Permanent wheat and gram plot	...	...	
(d) Permanent wheat plot	...	...	

III.—*Manurial experiments (statements 9, 5 B and 6).—*

(a) Bone meal, 5 cwt. per acre, <i>versus</i> no manure	...	} on barani area.
(b) Super 1½ cwt. per acre, <i>versus</i> no manure	...	
(c) Phosphates + ammonium sulphate	...	
(d) Phosphates + green manure	...	} on chahi area.
(e) Phosphates + farm yard manure	...	

The first mentioned tests, those shown in statements 4 and 8, have been put on a more satisfactory footing this year than was the case before : but the conditions of the year, especially the heavy rain which fell on the crop just after it had been cut renders their continuance for some years more than usually necessary. So far as they go, the average of the various tests shown in statement 4, is as follows : in lbs : of grain per acre. The tests were duplicated in all cases.

CHAHÍ					
<i>Punjab 11.</i>	<i>Punjab 17.</i>	<i>Pusa 12.</i>	8 A.	8 B.	
1,791	2,460	2,030	2,660	2,205	
<i>Barani.</i>					
<i>Punjab 14.</i>	<i>Pusa 12.</i>	8 A.	8 B.	20 C.	17 B.
1,293	1,208	1,398	1,083	1,292	1,531

8 A has not a good look in the field, but has topped all wheats in outturn in the chahi area. It has also done well in the barani area : and, as it is a bearded white wheat, it may possibly satisfy our requirements for both kinds of soil. It is an obvious advantage to have as few types as possible for distribution. It will be given a very extensive trial next year on the farm and to a small extent outside, among selected zamindars. Among the beardless chahi wheats, Punjab 17 gives good results. In the barani area the local 14 as usual did well.

17 B appears to be a good barani wheat. It has done well both on good and poor soils, unlike Pusa-12 which fares badly on poor land. It is a beardless red hard wheat, while Pusa-12 is white and soft grained. The season, especially at harvesting, was perhaps more unfavourable to Pusa 12 than to the other wheats, as the storms which occurred while it was lying cut on the field knocked out much of its grain. It is an earlier wheat than the others and therefore suffered more from these storms than the other wheats.

Hot weather cultivation does not pay, as was pointed out last year. This is being dropped.

Deep ploughing has again given better results than shallow ploughing, (statement 8, sabul plough *versus* country plough). Two ploughings with the country plough were given against one with the sabul plough. The plots cultivated with country plough were not cultivated with any iron plough.

Permanent wheat plot.—This experiment has been going on for the last four years. Wheat follows wheat every year. No manure and no irrigation is given, and no other crop is grown. The plots have shown a slight decrease in outturn.

Permanent wheat and gram (mixed) plot.—This experiment has been going on for two years. No manure and no irrigation is given. It is too early to deduce any results.

As regards manurial tests results are as usual against manures financially. The manured plots give better outturns, but the increase does not warrant the use of these manures, as it does not cover their cost. Experiments with phosphatic manures combined with nitrogenous manures are discussed below under fertilizers.

Pusa wheats.—A few words may be added about the Pusa wheats. They have also been discussed in previous reports. Pusa 4 and Pusa 12 were selected out of a number of those obtained in 1911 as the most promising. Pusa 4 needs very good conditions of soil, irrigation and cultivation : it has a short growing period, and is earlier than even Pusa 12. It is not doing well on the whole. It is a beardless white wheat with good large grains, which give an excellent sample : given quite favourable conditions, it gives very high outturns. Pusa 12 is also a beardless white wheat with a very good grain. It has become very popular in the central districts ; and it is now extensively grown in the Jullundur, Hoshiarpur and Gurdaspur districts. But Pusa 12 needs better conditions of cultivation, soil and moisture than do the local types, which do better than any outside type under adverse conditions. This year and its predecessor were dry, and the tests made in them are interesting : see especially those in statements 8 and 4. Pusa 12 was beaten by most of the local varieties, in both chahi and barani lands. But as already said the season was unduly adverse to it. Both these Pusa wheats are early : generally this is an advantage to them (though not this year) as they ripen before the hot winds set in which shrivel the grain. For eating they are very popular. Like most beardless wheats, they shed their grain with ease, and this is a distinct disadvantage to them. Statement 8 shows that it responds to deep cultivation more than does the local variety, Punjab 14.

Statement 11 shows the results given by the wheat crosses sent to the farm for testing by Mr. Howard, Imperial Economic Botanist. He sent 16 such crosses in 1915. The seed was so small in amount that only a few lines of each could be grown. Mr. Howard visited the farm in February 1916, and discarded three of them as liable to rust. This year the remaining 13 were grown on a much larger area, both chahi and barani. The rain damaged the crop to a large extent. The chahi crop was an excellent one ; but immediately after the crop had been cut and was lying in the fields, there was a sudden very heavy downpour

(5.73") of rain in a few hours; the field was flooded, and all the varieties were carried to one corner and mixed. Only four of them had been threshed before the rains, and they gave higher outturns than any other wheat on the farm. Cross N H₄ × P₆ appears to be a very promising chahi wheat. It is a beardless white with large ears, and stands well. It will be given a good test next year with the other chahi wheats. In the barani area the majority of the crosses on Pusa 4 did not do well; and have been discarded so far as barani tests go; those on Pusa 6 did better and have been kept on. All of these will be given another trial: crosses on Pusa 4 will be tested under irrigation only, and those on Pusa 6 both under chahi and barani conditions.

Residual effect on wheat of manures applied to the preceding sugarcane crop (statement 7).—This is the first year of this experiment and the results hardly merit discussion. The wheat was spoiled by rain after harvesting and on the threshing floor.

Fertilizers—(statements 5 A, 5 B, 6, 7, 9, and 10).—The three new series of manurial experiments mentioned above were initiated in the year under report. They are as follows:—

1. *Phosphatic manures (superphosphate or bonemeal) plus farmyard manure.*—The rotation is maize, wheat, maize wheat. The manure to be applied to maize alone before the crop is sown. Crop is irrigated. Details will be found in statements 5 A and 5 B.
2. *Phosphatic manures (superphosphate or bonemeal) plus green manure.*—The green manuring crop was san hemp which was ploughed in during August. The rotation on this plot—all irrigated—is san hemp (ploughed in), wheat, maize, wheat, san hemp (ploughed in), wheat, maize, wheat. Thus wheat crop is taken every year and maize in alternate years with san hemp. Half the manure to be applied to san hemp and the other half to maize before either is sown. Details are found in statement 6. Generally the manure does not pay.
3. *Phosphatic manure (superphosphate or bonemeal) plus ammonium sulphate on barani land.*—Details are in statement 10. Wheat is grown every year. The manure is all applied before sowing. In no case did the manure pay.

All these experiments must continue for some years before definite results are arrived at.

Fodders.—Some work has been started this year on fodders. Mangel wurzle, berseem and shaftal were tried this year (on chahi land) besides lucerne and senji (melilotus karviflora), which are ordinarily grown for fodder. The seeds were received late; and the outturns were not satisfactory, but mangel wurzle and shaftal are promising. The latter and senji make a good mixture for sowing together: and give both early and late green fodders. Senji is ready in December for early green fodder, and continues till the end of January when shaftal is nearly ready for feeding. This continues in its turn till the end of May.

Poultry.—There is only one breed—Leghorns. The birds do very well and the results are very encouraging. They are in much demand. Males are distributed in the district to improve the local breed. There is a great demand for their eggs during the hatching season.

General.—The methods advocated by the department got generally most satisfactory confirmation in the high yields the barani wheat plots on the farm yielded despite the dry winter: see statements 4 and 8. Barani wheat, unmanured, gave an average outturn of over 15 maunds per acre: and in the irrigated area the average outturn was over 26 maunds per acre, with only two irrigations. These results were of course due to good cultivation, and were very much higher than those obtained anywhere in the surrounding neighbourhood.

The farm is increasing greatly in popularity, and many visitors, including His Honour the Lieutenant-Governor, came to it last year. It is satisfactory that arrangements are now being made to provide satisfactory accommodation for Indian visitors at the farm.

FATEH-UD-DIN,

Offg. Deputy Director of Agriculture, Punjab.

Statement 1.

RAINFALL DURING THE YEAR 1915-16 AND 1916-17 IN INCHES.

Month.					1915-16.	1916-17.
June	...	...	...	...	62	18
July	...	...	...	...	39	652
August	...	...	...	...	479	476
September	...	...	...	...	283	459
October	...	...	...	...	197	2
November	...	...	...	...	...	...
December	...	...	...	...	07	...
January	...	...	...	...	1	3
February	...	...	...	...	131	...
March	...	...	...	...	23	9
April	...	...	...	...	36	707
May	...	...	...	...	52	158
Total					167	3472

Statement 2.
TESTS OF SUGARCANE VARIETIES.

Name of variety.	Area har-vested in square yards.	Weight of canes in lbs.	Weight of juice in lbs.	Weight of gur in lbs.	Weight of canes per acre in lbs.	Weight of juice per acre in lbs.	Weight of gur per acre in lbs.	Percentage of juice to canes.	Percentage of gur to juice.	Percentage of gur to canes.	REMARKS.
Kanara	1,287	8,548	5,152	753	32,128	19,375	2,832	60.80	14.62	8.81	
Yuba	581	6,819	3,949	688	56,805	32,897	5,315	57.92	16.15	9.35	
Behar	1,894	16,260	10,738	1,761	41,551	27,440	4,500	66.07	16.89	10.82	
Kansar	387	3,009	1,687	298	37,382	21,098	3,727	58.07	17.66	9.904	Rajah plough = 1.
Burji	1,378	15,310	8,763	1,253	53,774	30,779	4,401	57.23	14.3	8.183	Spring-tined harrow = 6.
Beera of Benares	2,170	23,616	14,152	2,098	52,878	31,564	4,679	59.92	14.83	8.694	Sohaga = 10.
Mango	2,061	23,168	12,116	1,705	54,402	33,452	4,008	52.31	14.07	7.958	Hoings = 4.
Katara	648	4,691	2,310	388	35,088	16,507	2,510	47.11	15.2	7.16	Waterings = 6.
Nargori	1,408	9,891	5,714	959	84,000	19,642	3,297	57.78	16.78	9.696	Date of sowing—16th March 1916.
Khori	1,020	9,809	5,610	899	44,172	26,620	4,285	60.27	16.08	9.658	Crushing commenced on 19th December 1916; finished on 6th February 1917.
Dhaura of Azamgarh	2,100	25,579	12,897	1,925	58,954	28,725	4,487	50.40	14.98	7.525	
Sanabelli	1,955	20,035	10,573	1,736	49,601	26,176	4,298	52.78	16.42	8.666	
Suretha	605	7,199	3,785	708	57,592	30,280	5,664	52.59	18.70	9.835	
Lalri	190	1,080	535	105	27,512	13,628	2,675	49.55	19.63	9.738	
Dhanu	20,257	169,084	84,641	14,668	40,402	20,223	3,505	60.05	17.34	8.676	Rajah plough = 1. Country plough = 8. Sohaga = 26. Hoings = 4. Waterings = 5. Date of sowing—23rd March 1916. Crushed from 12th December 1916 to 18th February 1917.

Statement 3.

COMPARATIVE TESTS OF MAIZE VARIETIES.

No. of field.	Variety.	Area reaped, in square yards.	Actual outturn in lbs.	Outturn per acre in lbs.	REMARKS.
10 A	Local	3,854	1,528	1,912	Rajah plough = 1. Country plough = 3. Springtined harrow = 1. Sohaga = 4. Hoeing = 3. Date of sowing—19th June 1916. Date of harvesting—11th October 1916.
	Sargodha	3,854	1,628	2,044	
10 B	Local	4,244	1,252	1,428	Rajah plough = 1. Country plough = 5. Springtined harrow = 1. Sohaga = 5. Hoeings = 3. Date of sowing—19th June 1916. Date of harvesting—7th October 1916.
	Jaunpore	4,244	1,037	1,182	
5	Local	5,491	1,974	1,740	Rajah plough = 1. Country plough = 1. Springtined harrow = 4. Sohaga = 6. Hoeings = 3. Date of sowing—13th July 1916. Date of harvesting—8th October 1916.
	Jullunduri	5,491	1,623	1,489	
	Peshawari	4,314	837	939	
	Kangra (red)	514	111	1,045	
	Kangra (white)	514	125	1,177	

Statement 4.

COMPARATIVE TESTS OF WHEATS.

No. of field.	Name of variety.	Area reaped in square yards.	ACTUAL OUTTURN IN LBS.		OUTTURN PER ACRE IN LBS.		REMARKS.
			Grain.	Straw.	Grain.	Straw.	
1	CHARI.						
	S A ...	1,298	708	1,262	2,640	4,705	
	Pusa 12 ...	1,298	576	1,876	2,147	6,995	
	S B ...	1,298	621	1,514	2,815	5,644	
	Pusa 12 ...	1,298	508	1,837	1,894	6,849	
	Punjab 17 ...	1,298	528	1,703	2,714	6,353	
	Pusa 12 ...	1,298	650	2,013	2,423	7,506	
	Punjab 11 ...	1,298	527	1,476	1,965	5,503	
	Pusa 12 ...	1,298	515	1,701	1,932	6,312	
	S A ...	1,298	722	1,510	2,692	6,376	
	Pusa 12 ...	1,298	549	1,944	2,047	7,743	
	S B ...	1,298	562	1,674	2,065	6,242	
	Pusa 12 ...	1,298	541	2,038	2,017	7,529	
	Punjab 17 ...	1,298	592	1,582	2,207	5,868	
	Pusa 12 ...	1,298	560	2,089	2,088	7,789	
	Punjab 11 ...	1,298	434	1,685	1,817	6,283	
	Pusa 12 ...	1,298	455	1,701	1,696	6,342	
	BAPANI.						
	S A ...	1,021	284	745	1,316	3,532	
	Punjab 14 ...	1,021	360	755	1,706	3,579	
16	S B ...	1,021	313	901	1,481	4,271	
	Punjab 14 ...	1,021	376	897	1,782	4,252	
	20 C ...	1,021	366	654	1,735	3,100	
	Punjab 14 ...	1,021	369	636	1,706	3,015	
	17 B ...	1,021	401	867	1,901	4,583	
	Punjab 14 ...	1,021	327	866	1,550	4,105	
	Pusa 12 ...	1,021	337	663	1,597	3,157	
	Punjab 14 ...	1,021	341	666	1,616	3,157	
	S A ...	1,021	306	773	1,451	3,664	
	Punjab 14 ...	1,021	249	512	1,130	2,428	
	S B ...	1,021	144	442	683	2,095	
	Punjab 14 ...	1,021	130	272	616	1,239	
	20 C ...	1,021	179	288	849	1,366	
	Punjab 14 ...	1,021	195	473	924	2,243	
	17 B ...	1,021	245	455	1,161	2,157	
	Punjab 14 ...	1,021	191	346	905	1,640	
	Pusa 12 ...	1,021	173	289	820	1,376	
	Pusa 14 ...	1,021	200	455	948	2,157	

Average soil.

Poor soil.

Rajah plough = 2.
Country plough = 3.
Springtined harrow = 11.
Sahaga = 10.
Wheat harrowings = 3.
Date of sowing — 26th October 1916.
Date of harvesting — 3d and 17th April 1917.

Statement 5 A

SHOWING THE RESULTS OF SUPER AND BONE MEAL IN CONJUNCTION WITH FARMYARD MANURE ON MAIZE.

No. of field	Variety	Area harvested in square yards	Treatment	Actual outturn in lbs.	Outturn per acre in lbs.	Increase or decrease per acre, in lbs.	Price of increase or decrease at Rs. 2-4-0 per maund.	Price of manure per acre.	Profit and loss per acre.	REMARKS.
9 B Local	...	1,342	Farmyard manure = 40 lbs. N per acre ...	341	1,230	...	...	Rs. A. P.	Rs. A. P.	
9 B Local	...	1,342	Farmyard manure = 40 lbs. N per acre + bone meal = 20 7/16 lbs. P, O, per acre.	361	1,374	144	3 10 9	5 2 8	-1 7 6	Rajabplough=1. Springtined harrows=3. Sohaga=2. Hoeing=3. Date of sowing—29th July 1916. Date of harvesting—18th October 1916.
9 B Local	...	1,342	Farmyard manure = 40 lbs. N per acre + super = 20 7/16 lbs. P, O, per acre.	455	1,640	410	10 7 6	5 9 8	+4 13 10	

Statement 5 B

SHOWING THE RESULTS OF THE RESIDUAL EFFECT OF SUPER AND BONE MEAL IN CONJUNCTION WITH FARMYARD MANURE ON WHEAT.
(Manures were applied to maize in Kharif 1916.)

1	2	3	4	5		6		7		8	9	10	11	12	13
No. of field and plot.	Name of variety.	Area reaped, in square yards.	Previous treatment.	ACTUAL OUTTURN, IN LBS.		OUTTURN, PER ACRE, IN LBS.		INCREASE OR DECREASE PER ACRE, IN LBS.		Price of grain, at Rs. 3-8-0 per maund, of increase or decrease.	Price of straw, at Rs. 0-8-0 per maund, of increase or decrease.	Total of columns 8 and 9.	Previous profit or loss on maize.	Net profit and loss.	REMARKS.
				Grain.	Straw.	Grain.	Straw.	Grain.	Straw.						
9 B										Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	
1		671	Farmyard manure = 40 lbs. N per acre	193	492	1,392	3,549	...	...	...	...	...	...	...	
9 B		671	Farmyard manure = 40 lbs. N per acre + bone meal = 20.76 lbs. P ₂ O ₅ per acre.	144	344	1,039	2,451	- 353	- 1,068	- 15 0 9	- 6 8 0	- 21 8 9	- 0 11 9	- 22 4 6	
9 B		671	Farmyard manure = 40 lbs. N per acre + super = 20.76 lbs. P ₂ O ₅ per acre.	220	689	1,587	4,969	+ 195	+ 1,420	+ 8 3 6	+ 8 8 0	+ 16 11 6	+ 2 6 11	+ 19 2 5	
9 B	Pusa 12.	671	Farmyard manure = 40 lbs. N per acre	204	693	1,471	4,998	...	...	...	...	...	...	...	Rajah plough = 1; Springtined harrow = 4; Schaga = 4; Wheat harrow- ings = 1; Irrigation = 1. Date of sowing - 31st October 1916. Date of harvesting - 5th April 1917.
9 B		671	Farmyard manure = 40 lbs. N per acre + bone meal = 20.76 lbs. P ₂ O ₅ per acre.	156	370	1,126	2,668	- 345	- 2,390	- 14 0 0	- 13 15 3	- 27 15 3	- 0 11 9	- 28 11 0	
9 B		671	Farmyard manure = 40 lbs. N per acre + super = 20.76 lbs. P ₂ O ₅ per acre.	208	500	1,501	3,607	+ 39	- 1,391	+ 1 4 5	- 8 7 3	- 7 2 9	+ 2 6 11	- 4 11 10	

N.B.—As the price of farmyard manure is the same in all cases it is omitted in calculation.

Statement 6.

SHOWING THE RESULTS OF SUPER AND BONE MEAL IN CONJUNCTION WITH GREEN MANURING (SAN HEMP) ON WHEAT.

1	2	3	4		5	6		7	8	9	10	11	12	
No. of field and plot.	Area harvested, in square yards.	Treatment.	ACTUAL OUTPUT, IN LBS.		OUTTURN PER ACRE, IN LBS.	INCREASE OR DECREASE PER ACRE IN LBS.		Price of grain, at Rs. 8-0 per maund, of increase or decrease.	Price of straw, at Rs. 0-8-0 per maund, of increase or decrease.	Total of columns 8 and 9.	Price of manure per acre.	Profit or loss per acre.	REMARKS.	
			Grain.	Straw.		Grain.	Straw.							
8 B 1	750	Unmanured	311	1,155	2,006	7,452	...	...	...	...	...	...	Unmanured plot had benefited by far more cultivation than the rest of the field. It was the plot where frequent demonstrations of ploughings and harrowings were given to outside parties visiting the farm and consequently this plot got frequent deep cultivation and was in a far better condition of tilth; hence omitted from profit and loss account.	
8 B 2	750	Green manure	305	1,177	1,968	7,595	...	...	...	...	...	...		
8 B 3	750	Green manure + super = 2076 lbs P ₂ O ₅ per acre.	329	1,129	2,123	7,285	+ 155	- 312	+ 6 8 9	- 1 9 0	+ 4 15 9	5 9 8	- 0 9 11	N.B.—As green manuring was done in the whole of the remaining field, its cost has not been calculated.
8 B 4	750	Green manure + bone meal = 2076 lbs. P ₂ O ₅ per acre.	316	1,162	2,040	7,499	+ 72	- 96	+ 3 1 0	- 0 9 8	+ 2 7 9	5 2 8	- 2 10 6	Rajah plough = 1.
8 B 5	750	Green manure	307	1,021	1,981	6,568	...	...	...	...	...	...	...	Country plough = 2.
8 B 6	750	Green manure + super = 2076 lbs. P ₂ O ₅ per acre.	321	1,054	2,071	6,995	+ 90	+ 407	+ 3 13 8	+ 2 2 8	+ 5 15 6	5 9 8	+ 0 5 10	Spring tined harrow = 2.
8 B 7	750	Green manure + bone meal = 2076 P ₂ O ₅ per acre.	313	1,024	2,020	6,608	+ 89	+ 19	+ 1 11 3	+ 0 1 10	+ 1 13 1	5 2 8	- 3 5 2	Sohaga = 6.
														Wheat harrowing = 1.
														Date of sowing—25th October 1916.
														Date of harvesting—5th April 1917.

Statement 7.

SHOWING THE RESIDUAL EFFECT OF CHEMICAL MANURES (APPLIED TO SUGARCANE IN 1915 ON WHEAT.

No. of field.	Name of variety.	Area respod, in square yards.	Previous treatment.	ACTUAL OUT-TURN, IN LBS.		OUTTURN PER ACRE, IN LBS.		REMARKS.
				Grain.	Straw.	Grain.	Straw.	
2 1	Pusa 4.	1,047	Unmanured	395	1,140	1,826	5,270	Rajah plough = 2. Country plough = 2. Spring tined harrow = 6. Sohaga = 5. Wheat-harrowing = 1. Watering = 2. Date of sowing — 22nd October 1916. Date of harvesting — 5th, 6th and 7th April 1917.
2 2		1,047	Ammonium sulphate = 200 lbs.; lime = 2,000 lbs. per acre.	388	1,345	1,770	6,218	
2 3		1,047	Unmanured	327	1,252	1,511	5,788	
2 4		1,047	Pot. sulphate = 200 lbs. per acre; super = 200 lbs. per acre.	442	1,296	2,043	5,992	
2 5		1,047	Pot. sulphate = 200 lbs. per acre; super = 200 lbs. per acre; ammonium sulphate = 200 lbs. per acre; lime = 2,000 lbs. per acre :	407	1,274	1,881	5,839	
2 6		1,047	Pot. sulphate = 200 lbs. per acre; super = 200 lbs. per acre.	436	1,322	2,016	6,111	
2 7		1,047	Unmanured	366	1,129	1,692	5,219	
2 8		1,047	Ammonium sulphate = 200 lbs. per acre; lime = 2,000 lbs. per acre;	387	1,057	1,788	4,887	
2 9		1,047	Unmanured	331	1,047	1,590	4,840	
2 10		1,047	Unmanured	344	1,328	1,590	6,189	
2 11		1,047	Super = 200 lbs. per acre; lime = 2,000 lbs. per acre;	401	1,366	1,854	6,314	
2 12		1,047	Unmanured	374	1,144	1,729	5,288	
2 13		1,047	Pot. sulphate = 200 lbs. per acre; ammonium sulphate = 200 lbs. per acre;	379	1,380	1,752	6,380	
2 14		1,047	Pot. sulphate = 200 lbs. per acre; ammonium sulphate = 200 lbs. per acre; super = 200 lbs. per acre; lime = 2,000 lbs. per acre;	360	1,287	1,664	5,950	
2 15		1,047	Pot. sulphate = 200 lbs. per acre; ammonium sulphate = 200 lbs. per acre;	463	854	2,140	3,948	
2 16		1,047	Unmanured	477	1,358	2,205	6,277	
2 17		1,047	Super = 200 lbs. per acre; lime = 2,000 lbs. per acre;	420	1,666	1,941	7,702	
2 18		1,047	Unmanured	463	1,650	2,232	7,628	

Statement 8.

EFFECT OF CULTIVATION ON WHEAT.

No. of field.	Area harvested, in square yards.	Name of variety.	Cultivation.	ACTUAL OUT-TURN, IN LBS.		OUTTURN, PER ACRE, IN LBS.		REMARKS.
				Grain.	Straw.	Grain.	Straw.	
18	2,457	Punjab 14	Hot weather cultivation.	753	1,650	1,484	3,250	Raja plough = 2. Country plough = 2. Spring-tined harrows = 12 Sohaga = 9. Wheat harrowing = 3. Date of sowing—16th and 17th October 1916. Date of harvesting—3rd, 4th, 16th and 17th April 1917. Hotweather cultivation plots received 6 ploughings with country plough extra in May and June.
18	2,457	Pusa 12	Ditto	676	1,275	1,331	2,511	
18	2,457	Punjab 14	Ordinary cultivation.	763	1,734	1,503	3,415	
18	2,457	Pusa 12	Ditto	716	1,450	1,410	2,856	
18	2,332	Punjab 14	Sabul plough	481	1,155	998	2,396	Sabul plough = 2. Country plough = 2. Spring-tined harrows = 12. Sohaga = 9. Wheat harrowing = 3. Date of sowing — 16th and 17th October 1916. Date of harvesting — 3rd, 4th, 16th and 17th April 1917.
18	2,457	Pusa 12	Ditto	551	924	1,085	1,820	
18	2,282	Punjab 14	Country plough	401	991	850	2,102	Country plough = 6. Spring-tined harrows = 12 Sohaga = 9. Wheat harrowing = 3. Date of sowing — 16th and 17th October 1916. Date of harvesting — 3rd, 4th, 16th and 17th April 1917.
18	2,457	Pusa 12	Ditto	327	732	644	1,442	
18	3,276	Pusa 12 and gram.	Permanent wheat and gram plot.	636	1,674	940	2,474	Rajah plough = 3. Country plough = 3. Spring-tined harrows = 7. Sohaga = 9. Wheat harrowing = 2. Date of sowing—18th October 1916. Date of harvesting — 4th April 1917.
17	3,224	Pusa 12	Permanent wheat plot.	473	982	710	1,474	Rajah plough = 2. Country plough = 1. Spring = tined harrows = 8. Sohaga = 6. Wheat harrowing = 2. Date of sowing—18th October 1916. Date of harvesting—3rd April 1917.

Statement 9.

EFFECT OF BONE MEAL AND SUPER ON WHEAT YIELDS IN BARANI AREA.

1	2	3	4		5		6	7		8	9	10	11	12
No. of field and plot.	Name of variety.	Area harvested in square yards.	ACTUAL OUTPUT, IN LBS.		OUTPUT PER ACRE, IN LBS.		Manure and rate per acre.	INCREASE AND DECREASE PER ACRE, IN LBS.		Price of grain of increase or decrease.	Price of straw, at Re. 0-8-0 per maund, of increase or decrease.	Total of columns 8 and 9.	Price of manure per acre.	Profit or loss per acre.
			Grain.	Straw.	Grain.	Straw.		Grain.	Straw.					
18 15, 17, 19	Punjab 14	2,457	594	1,216	1,170	2,395	Bone meal = 5 cwt. per acre.	+ 230	- 103	+ 9 6 6	- 0 10 0	+ 8 12 6	Rs. A. P. 30 0 0	Rs. A. P. - 21 3 6
18 15, 17, 19	Pusa 12	2,457	603	1,008	1,188	1,985	Ditto	+ 347	+ 662	+ 14 12 7	+ 4 4 0	+ 19 0 7	30 0 0	- 10 15 5
18 16, 18, 20	Punjab 14	2,457	477	1,267	940	2,496	No manure	...	...	...	...	...	...	...
18 16, 18, 20	Pusa 12	2,457	427	672	841	1,323	Ditto	...	...	...	...	...	...	...
18 21, 23	Punjab 14	1,638	416	648	1,229	1,914	Super = 1½ cwt. per acre.	+ 372	+ 298	+ 13 8 4	+ 1 13 0	+ 15 5 4	9 12 3	+ 5 9 1
18 21, 23	Pusa 12	1,638	366	683	1,021	2,018	Ditto	+ 413	+ 602	+ 17 8 4	+ 3 10 9	+ 21 3 1	9 12 3	+ 11 6 10
18 22, 24	Punjab 14	1,638	290	547	857	1,616	No manure	...	...	...	...	...	...	...
18 22, 24	Pusa 12	1,638	226	479	668	1,416	Ditto	...	...	...	...	...	...	...

N.B.—Price is calculated at Rs. 3-8-0 per maund (82 lbs.) in case of white, and Rs. 3-6-0 in case of red wheat.

Statement 10.

SHOWING THE RESULTS OF BONE MEAL AND SUPER IN CONJUNCTION WITH AMMONIUM SULPHATE ON WHEAT IN BARANI AREA.

No. of field and plot.	Name of variety.	Area harvested, in square yards.	Treatment.	ACTUAL OUTPUT, IN LBS.		OUTTURN PER ACRE, IN LBS.		INCREASE OR DECREASE PER ACRE, IN LBS.		PRICE OF INCREASE OR DECREASE.		Total.	Price of manure per acre.	Profit or loss.	REMARKS.
				Grain.	Straw.	Grain.	Straw.	Grain.	Straw.	Rs. A. P.	Rs. A. P.				
21 1		752	Control ...	76	148	489	953	...	...	Rs. A. P.	...	...	Rs. A. P.	Rs. A. P.	Rajah plough = 2. Country plough = 2. Spring-tined harrow = 9. Sohaga = 6. Wheat harrowing = 3. Date of sowing = 23rd October 1916. Date of harvesting = 3rd April 1917.
21 2		752	Am. sulphate = 20 lbs. N. per acre	111	224	714	1,441	+225	+488	+9 9 3	+2 15 6	+12 8 9	16 10 6	-4 1 9	
21 3		752	Am. sulphate + super = 15 lbs. P ₂ O ₅ per acre.	121	183	779	1,178	+290	+225	+12 5 6	+1 6 0	+13 11 6	20 10 6	-6 15 0	
21 4		752	Am. sulphate + bone meal = 15 lbs. P ₂ O ₅ per acre.	135	274	850	1,764	+361	+811	+15 5 9	+4 14 9	+20 4 6	20 5 3	-0 0 9	
21 5		752	Control ...	130	253	837	1,629	...	...	...	...	...	...	...	
21 6		752	Am. sulphate = 20 lbs. N. per acre	138	285	888	1,512	+51	-117	+2 2 2	-0 11 6	+1 7 3	16 10 6	-15 3 3	
21 7		752	Am. sulphate + super = 15 lbs. P ₂ O ₅ per acre.	169	344	1,030	2,214	+193	+535	+8 3 6	+3 9 0	+11 12 6	20 10 6	-8 14 0	
21 8		752	Am. sulphate + bone meal = 15 lbs. P ₂ O ₅ per acre.	154	296	991	1,905	+154	+276	+6 8 9	+1 10 9	+8 3 6	20 5 3	-12 1 9	
21 9		752	Control ...	156	294	1,004	1,882	...	...	...	...	...	...	...	
21 10		752	Am. sulphate = 20 lbs. N. per acre	146	323	940	2,117	-64	+235	-2 11 6	+1 6 0	-1 5 6	16 10 6	-18 0 0	
21 11		752	Am. sulphate + super = 15 lbs. P ₂ O ₅ per acre	176	364	1,127	2,343	+123	+451	+5 3 9	+2 12 0	+7 15 9	20 10 6	-12 10 9	
21 12		752	Am. sulphate + bonemeal = 15 lbs. P ₂ O ₅ per acre.	186	278	875	1,788	-129	-104	-5 7 9	-0 10 0	-6 1 9	20 5 3	-26 7 0	

Statement 11.

RESULTS OF WHEAT CROSSES SENT BY MR. HOWARD (IMPERIAL ECONOMIC BOTANIST).

Field No.	Name of variety.	Area harvested, in square yards.	ACTUAL OUTTURN, IN LBS.		OUTTURN PER ACRE, IN LBS.		REMARKS.
			Grain.	Straw.	Grain.	Straw.	
BARANI.							
22	N. H ₉₃ × P ₄ ...	172	14	88	394	2,477	Rajah plough = 2. Country plough = 3. Spring-tined harrow = 12. Sohaga = 9. Wheat harrowing = 3. Date of sowing - 23rd October 1916. Date of harvesting - 5th, 16th, and 17th April 1917.
	N. H ₁₀₅ × P ₄ ...	212	33	100	753	2,383	
	N. H ₉₀ × P ₄ ...	310	21	141	828	2,201	
	N. H ₉₅ × P ₄ ...	422	80	197	918	2,259	
	N. H ₄₀ × P ₄ ...	473	86	236	880	2,414	
	N. H ₅₅ × P ₄ ...	593	111	323	906	2,636	
	N. H ₄₅ × P ₄ ...	908	245	681	1,806	3,630	
	N. H ₄ × P ₆ ...	124	29	94	1,132	3,669	
	N. H ₅ × P ₆ ...	203	37	153	882	3,767	
	N. H ₁₉ × P ₆ ...	339	72	165	1,028	2,355	
	N. H ₂₅ × P ₆ ...	773	201	590	1,258	3,694	
	N. H ₁₁ × P ₆ ...	1,138	204	464	867	1,973	
	N. H ₁₃₁ × P ₆ ...	973	146	173	726	860	
CHAHIL.							
6-C	N. H ₄ × P ₆ ...	159	107	327	3,257	9,954	Rajah plough = 2. Country plough = 2. Spring-tined harrow = 6. Sohaga = 9. Wheat harrowing = 1. Irrigations = 2. Date of sowing - 22nd October 1916. Date of harvesting - 14th and 15th April 1917.
	N. H ₅ × P ₆ ...	159	84	300	2,557	9,132	
	N. H ₂₅ × P ₆ ...	318	181	564	2,755	8,584	
	N. H ₁₁ × P ₆ ...	318	196	662	2,984	10,076	

N.B.—The remainder of the crosses on the chahi area were all inextricably mixed up by rain, and hence no results are available for them separately: but the mixture gave an outturn of 2,984 lbs. per acre.

APPENDIX VIII.

Report of the Deputy Director of Agriculture, Punjab, Hansi, on the
Hansi Farm.

SEASON AND ITS EFFECTS.

THE total rainfall during the year on the farm—the second since it came into existence—(vide statement 1) was 20·14 inches as compared with 4·59 in the preceding year. We had very good rains in August, September and October and these greatly helped in the preparation of land for and the sowing of rabi crops. But after that practically the whole of the winter was rainless: we had no Christmas rains, and our barani crops, suffered much. The season was favourable for nahri (canal irrigated) rabi crops, and very good harvest was expected from them, but the rain and hail that fell at harvesting time did considerable damage and also delayed threshing.

The wheats at the farm were free from rust or any other disease.

As was foretold last year, our experiments with kharif crops have suffered from shortage of water at sowing time; this particularly affected, and delayed cottons. Indeed 10 acres of our experimental cottons were so late that the results in them were valueless.

NATURE OF THE LAND.

One of the most unfortunate circumstances on this farm is that the land is extremely uneven in nature, and kallar patches show their appearance in almost every plot in varying dimensions. Thus even with the most careful selection, and the grouping fields of equal quality in one set, it is as yet most difficult to arrive at accurate results. This evil will of course get less as time goes on owing to good and regular cultivation.

COTTONS.

About 36 acres of cotton, including environment experiment of the Economic Botanist and the parasite breeding plot, were grown at the farm during the year, but out of these 10 acres have to be, as already said, disregarded, owing to the scarcity of water. The experiments carried out are as follows:—

Four different varieties of American cotton—i.e. 280 F, 275 F, 4 F and 161 A. F, and 10 of desi (country) cottons, Neglectum white flowered Bhatla selection, Indicum white flowered Bhatla selection, Neglectum yellow flowered Bhatla selection, Indicum yellow flowered Bhatla selection, Local Bhatla, Rosea 87, Rosea 132, Mollisoni 24 and Indicum 133 b were tried against Indicum 135 a. Among the Americans 280 F has on average given the highest yield of kapas (unginned cotton), i.e., Mds. 9-36-0 per acre or 810 lbs. (statements 2 and 3). It has also a greater "kan" or ginning percentage than the other exotic varieties, and it has been valued above the other varieties by the Karachi Chamber of Commerce. Among the indigenous cottons the highest yield is that of Neglectum white flowered Bhatla selection which gave an average Mds. 11-10-0 = (922 lbs.) per acre of kapas in varietal test plots (statement 2). In another experiment it has given as a high yield as Mds. 16-33-0 = (1,378 lbs.). Other promising varieties are—Indicum white flowered Bhatla selection, Local Bhatla and Rosea 132 which have given Mds. 10-34 = (888 lbs.), Mds. 10-34-0 = (888 lbs.) and Mds. 10-25-0 = (876 lbs.) of kapas respectively. The kan was 33·8, 35·0 and 36·8 respectively. Sanguineum 20 A has given the lowest yield, Mds. 3-38-0 = (322 lbs.) per acre and so confirms our last year's experience, that Sanguineum cotton is not suitable for this tract.

These were tried with (1) American cotton 4 F and (2) Indicum white flowered Bhatla selection. In the case of 4 F spacings were 4', 3½' 3' and 2½'. The experiment was in duplicate. For detailed results see statement 4. Average yield per acre were:—

4 feet	...	Mds. 11-25-0 = (952 lbs.).
3½ feet	...	" 13-4-0 = (1,074 lbs.).
3 feet	...	" 13-19-0 = (1,104 lbs.) : best.
2½ feet	...	" 13-15-0 = (1,096 lbs.).

Spacing experiment with Indicum white flowered Bhatla selection (statement 5.).

2½ feet	...	Mds. 7-36-0 = (646 lbs.).
2 feet	...	" 8-32-0 = (720 lbs.).
1½ feet	...	" 10-13-0 = (846 lbs.) best.

The following experiments :—

- (1) Broadcasting *versus* sowing in lines
- (2) Different number of hoeings in broadcasted cotton
- (3) Same number of different hoeings in line sown cottons
- (4) Deep and shallow cultivation for cotton before sowing

could not be carried out, as the cottons for these experiments became too late due to scarcity of canal water, and, germination being unsatisfactory, had to be destroyed.

Seed rate experiment with cotton sown
(1) in lines and (2) broadcast.

For details see statement 6.

The experiment was tried with white flowered Neglectum Bhatla selection in one-tenth acre plots.

(1) *In lines* :—The seed rate in the case of cotton sown in lines was 6 seers, 5 seers, 4 seers, 3 seers and 2 seers per acre. Five seers per acre gave the highest yield, *i.e.*, Mds 16-33-0 (1,378 lbs.).

(2) *Broadcast*.—The seed rate in this case was 10 seers, 8 seers, 6 seers, 5 seers and 4 seers per acre. The highest yield was in the case of 8 seers per acre, *i.e.*, Mds. 13-5-0 per acre (1,076 lbs.)

The experiment was tried with Neglectum white flowered, and the plants were thinned when 3 feet, 2 feet and 1 foot high, respectively. For full details see statement 7. The best results were obtained in the case of field thinned when the plants were 2 feet in height.

Thinning cotton crop at different heights.

As most of the cotton in this tract is sown in the "wadh" of rabi crops, *i.e.*, immediately after them, it is important to know the effect of different seed rates on late sown American cottons and its comparison, with early sown Americans. An experiment in this matter was therefore conducted in 3 plots of $\frac{1}{4}$ acre each. In one plot 4 F cotton was sown at the usual time, *i.e.*, before the middle of April, at 8 seers per acre; in the other two plots it was sown in June, after the removal of the rabi crop, but the seed rate in one case was 6 seers, and in the other was 10 seers per acre. The results are interesting. The late sown American with the higher seed rate, although not so good as the early sown, is decidedly better than the late sown cotton with the lighter seed rate. Both the late sown cottons were sown on the same day. The results are—

Early sown 4 F	... Seed rate 6 seers	... Mds. 7-7-0 = (588 lbs.).
Late sown 4 F	... " " 6 "	... " 3-20-0 = (286 lbs.).
Late sown 4 F	... " " 10 "	... " 5-1-0 = (412 lbs.).

For full details see statement 8.

The results are of considerable economic value for this tract, and the experiment will be continued next year.

This experiment was conducted with two varieties of cotton, *i.e.*, 4 F and Neglectum yellow flowered Bhatla selected. In the case of the American the addition of ash has increased the produce of kapas by 19 seers per acre. In the case of Neglectum yellow flowered B. S. one plot where ash was added, gave 31 seers more than the adjacent field which received no ash, while its duplicate, owing to unevenness of soil, showed a decrease of Maunds 1-35. The experiment will again be continued.

Manual experiment with cotton
(statement 9) Ash *versus* no ash.

Fifty-eight plants of desi cotton having over 35 per cent. lint were selected from the pure strains of four Bhatla types. Most of the plants selected belonged to the white flowered varieties. Plants having percentage as high as 43.5 have been found: some have fairly fine and long staple. The seed from each plant has been sown in a separate line and further selections will be made from among these.

Plant to plant selection.

Environment experiment for the Economic Botanist, experiment of growing cotton after cotton in the same plot (statement 10), experiment as regards water requirement, and the effect of farm yard manure and nitrates on cotton are being tried. The latter is inconclusive. A parasite breeding plot of cotton for the entomological section is also reserved. Cotton is also being tried under barani conditions.

Miscellaneous.

WHEATS.

About 22 acres of wheat, including, 2 acres barani and 1 acre under 25 types of common Punjab types of wheat, were grown. A plot of one acre is permanently reserved for growing wheat after wheat to see its effect on the fertility of the soil.

Six varieties of wheat, *i.e.*, Pusa 12, Pusa 4, 8A, 8B, 20C and 17B were tried against Punjab 14. 8A has given the highest yield, *i.e.*, Mds. 29.16 = (lbs. 2,410) per acre. The yields of the other varieties are as follows :—

Varietal tests.

20C	...	Mds. 27—14	(lbs. 2,242)	Punjab 14	...	maunds 26	(lbs. 2,132).
Pusa 4	...	" 25—36	(lbs. 2,123)	8B	...	maunds 24—4	(lbs. 1,976).
Pusa 12	...	" 23—30	(lbs. 1,946)	17B	...	maunds 23—14	(lbs. 1,914).

The varieties were in duplicate. For full details see statement 11. Punjab 14 was also tested against Punjab 11, Pusa 4, Pusa 12 and Punjab 17 in another block (statement 12). The results are per acre :—

Punjab 14	...	Mds. 30—32	= (lbs. 2,525)	Punjab 11	Mds. 31—36	(lbs. 2,615).
Punjab 17	...	" 25—8	= (lbs. 2,066)	Pusa 4	" 22—32	(lbs. 1,869).
Pusa 12	...	" 19—8	= (lbs. 1,574).			

SUGARCANE.

The same 5 varieties of sugarcane as grown last year were tried this year. The varieties are :—

- 1 Local.
- 2 Mango of Benares.
- 3 Dhaura of Azimgarh.
- 4 Lalri of Samalkha.
- 5 Suretha of Samalkha.

The varieties were grown in two sets of land ; in one case metha (*trigonella fatnugraecum*) a leguminous crop, was removed before sowing : in the second case it was ploughed in as green manure. All varieties gave higher yields in the green manured plots. The results are as follows :—

<i>Metha removed.</i>				<i>Metha ploughed in as green manure.</i>			
Local	Mads. of gur	38-29-0	II	Local	Mads. of gur	39-32-0	IV.
Mango	" "	40-25-0	I	Mango	" "	46-18-0	III.
Lalri	" "	35-8-0	IV	Lalri	" "	51-32-0	II.
Suretha	" "	37-2-0	III	Suretha	" "	56-0-0	I.
Dhaura	" "	22-7-0	V	Dhaura	" "	25-28-0	V.

for full details see statement 13.

DROUGHT RESISTING FODDERS.

Attention is being paid to drought resisting grasses and other fodder plants. Thornless cacti and Sudan grass, etc., have been put in and seeds of Rhodes grass, *Artiplex leptocarpa*, *Artiplex hulimoides*, *Artiplex holocarpa*, *Artiplex semibacata*, *Artiplex nummularia* and *Paspalum dilatatum* have been obtained from Sutton and Co., Reading. They will be sown now.

Ten acres have been reserved for barani (rainfed) crops only. The soil of the farm is hard clay and not typical. Still the land is available, and cannot be irrigated. The work will continue.

Barani cultivation.

GROUNDNUT.

A small plot of land was sown with groundnut but the land being very hard it gave poor yields. The crop will be grown again in lighter soil. It should be useful in Haryana.

JAPAN SARSON.

Japan sarson and local sarson were sown for comparative tests. Japan sarson is good for fodder but is a poor yielder as regards seed.

BAJRA.

Australian and local bajra were tried both under irrigation and under barani conditions. The results so far are not conclusive.

JOWAR.

About 13 acres of local jowar and two of amber cane were grown for fodder purposes. Some varieties of Central Provinces jowar, *i.e.*, Chapti, Bam Khel, Sosner, and amber cane were also grown for seed and for comparative tests with local. All the first three are very late ripening and gave a very small yield of shrivelled grain, the most part of which was eaten up by birds.

SILAGE WITH JOWAR.

Nine hundred and twenty-two maunds and 33 seers of green jowar was buried in the silo pit on 1st September 1916 : it will be opened in August or September in order to see how it keeps over the hot months.

DARSHAN SINGH,

Deputy Director of Agriculture, Punjab, Hansi.

Statement No. 1.

RAINFALL DURING THE YEARS 1915-16 AND 1916-17 AT THE AGRICULTURAL STATION, HANSI.

Name of month.	Rainfall during 1915-16.	Rainfall during 1916-17.
June ...	0.93	1.14
July ...	1.92	2.97
August ...	0.12	7.44
September ...	0.65	2.88
October ...	0.18	2.42
November ...	...	...
December ...	0.07	...
January ...	0.14	0.09
February ...	0.21	.38
March ...	0.02	...
April ...	0.05	1.73
May ...	0.30	1.09
TOTAL ...	4.59	20.14

Statement No. 2.
VARIETAL TESTS OF COTTONS.

No. of block.	Name of variety.	Area cropped, square yards.	DATE OF			ACTUAL OUTTURN.			OUTTURN PER ACRE.			REMARKS.
			Sowing.	First picking.	Last picking.	Country weight.		English weight.	Country weight.		English weight.	
						Maunds.	Seers.	Pounds.	Maunds.	Seers.	Pounds.	
	Indicum, 135a	21,640	8th June 1917	23rd September 1916	23rd December 1916	33	6	2,728	7	16	610	
	Indicum 133b	987	Ditto	Ditto	Ditto	1	9	102	6	16	528	
	Neglectum Rosea 132	975	Ditto	Ditto	Ditto	2	5	176	10	25	874	
	161 A F	977	Ditto	17th October 1916	Ditto	1	1	84	5	3	417	
	Combodia	710	Ditto	23rd December 1916	Ditto	0	1	3	0	8	17	
	Indicum white flowered	1,770	Ditto	17th October 1916	Ditto	4	3	335	10	34	918	
	Neglectum white flowerd	2,130	Ditto	23rd September 1916	Ditto	4	38	408	11	10	928	Best yield.
	Neglectum yellow flowered	1,814	Ditto	Ditto	Ditto	3	5	258	8	14	688	
	Indicum yellow flowered	2,172	June 1916	Ditto	Ditto	2	32	230	6	10	514	
	Mollisoni, 24	2,147	Ditto	Ditto	Ditto	3	5	257	7	2	581	
	Rosea, 87	2,064	Ditto	Ditto	Ditto	3	33	315	8	15	619	
	Sanguineum	1,908	Ditto	Ditto	Ditto	1	35	156	4	32	395	
	Local Bhatla	2,172	Ditto	2nd September 1916	Ditto	4	35	401	10	31	898	
	Muttani	1,084	Ditto	9th November 1916	Ditto	1	33	151	8	8	674	
	199 F	904	Ditto	4th November 1916	Ditto	0	28	57	3	30	909	
	275 F	1,046	Ditto	17th October 1916	Ditto	1	33	150	8	18	607	
	280 F	1,084	Ditto	Ditto	Ditto	2	8	133	9	36	816	Best yield among American.

Statement No. 3.

OUTTURN OF DIFFERENT COTTONS.

No. of block.	No. of plot.	Name of variety.	Actual area in square yards.	Area cropped in square yards.	DATE OF			ACTUAL OUTTURN.				OUTTURN PER ACRE.			
					Sowing.	First picking.	Last picking.	Country weight.		English weight.	lbs.	Country weight.		English weight.	Pounds.
								Maunds.	Seers.			Maunds.	Seers.		
	14a	Indicum, 135 A	...	521	8th. June 1916	28rd September 1916.	28rd December 1916.	0	38	66		7	17	611	
	14b	Indicium, 133 B	...	987	Ditto	Ditto	Ditto	1	9	102		6	16	528	
	15a	Neglectum Rosea, 132	...	975	Ditto	Ditto	Ditto	2	5	176		10	25	874	
	15b	Indicum, 135 A	...	363	Ditto	9th October 1916	Ditto	0	13	28		4	23	376	
	16a	161 A F.	...	977	Ditto	17th October 1916.	Ditto	1	1	84		5	3	417	
	16b	Indicum, 135 A	...	544	Ditto	23rd September 1916.	Ditto	0	27	57		6	8	510	
	17a	Combodia	...	710	Ditto	23rd December 1916.	Ditto	0	1	3		0	10	20	
	17b	Indicum, 135 A	...	272	Ditto	23rd September 1916.	Ditto	0	21	44		9	23	789	
	18a	Indicum white flowered ...	...	805	Ditto	17th October 1916.	Ditto	1	11	104		7	26	630	
	18b	Indicum, 135 A	...	218	Ditto	28rd September 1916.	Ditto	0	24	51		13	33	1,188	
	19a	Neglectum white flowered	...	1,046	Ditto	Ditto	Ditto	2	7	179		10	4	831	
	19b	Indicum, 135 A	...	784	Ditto	Ditto	Ditto	0	29	61		4	23	376	
	20a	Neglectum yellow flowered	...	748	Ditto	Ditto	Ditto	1	16	115		9	3	747	
	20b	Indicum, 135 A	...	657	Ditto	Ditto	Ditto	0	32	67		6	0	495	
	21a	Indicum white flowered	...	1,088	7th June 1916	Ditto	Ditto	1	18	120		6	20	536	
	21b	Indicum, 135 A	...	1,088	Ditto	Ditto	Ditto	1	10	103		5	23	460	
	22a	Mollisoni, 24	...	1,088	Ditto	Ditto	Ditto	1	11	105		5	27	468	

223	Indicum, 135 A	...	...	1,088	1,088	7th June 1916 ...	23rd September 1916.	23rd December 1916.	1	6	95	5	6	425
23a	Rosa, 87	...	...	1,088	1,088	Ditto	Ditto	Ditto	1	38	162	8	31	722
23b	Indicum, 135 A	...	...	1,088	1,088	Ditto	Ditto	Ditto	1	9	102	5	21	455
24a	Sanguineum, 20 A	...	...	1,088	1,088	Ditto	17th October 1916.	Ditto	0	35	72	3	37	323
24b	Indicum, 135 A	...	...	1,088	1,088	Ditto	23rd September 1916.	Ditto	1	19	122	6	37	570
25a	Local Bhatia	...	...	1,088	1,088	Ditto	2nd September 1916.	Ditto	2	36	238	12	36	1,062
25b	Indicum, 135 A	...	...	1,088	1,088	Ditto	Ditto	Ditto	2	16	199	10	30	885
26a	4-F	...	...	1,088	1,088	Ditto	30th September 1916.	Ditto	2	7	179	9	28	799
26b	Indicum, 135 A	...	...	1,088	1,067	Ditto	2nd September 1916.	Ditto	3	0	247	13	25	1,122
14c	Indicum, 135 A	...	...	1,088	593	8th June 1916...	23rd September 1916.	Ditto	0	34	70	6	39	573
14d	Multani	...	...	1,088	1,084	Ditto	9th November 1916.	Ditto	1	33	151	8	8	624
15c	199 F	...	...	1,088	904	Ditto	Ditto	Ditto	0	28	57	3	30	909
15d	Indicum, 135 A	...	...	1,088	723	Ditto	23rd September 1916.	Ditto	0	21	44	3	25	298
16c	275 F	...	...	1,088	1,046	Ditto	17th October 1916.	Ditto	1	33	150	8	18	607
16d	Indicum, 135 A	...	...	1,088	990	Ditto	23rd September 1916.	Ditto	1	26	137	8	7	672
17c	280 F	...	...	1,088	1,084	Ditto	17th October 1916.	Ditto	2	8	183	9	33	816
17d	Indicum, 135 A	...	...	1,088	829	Ditto	27th September 1916.	Ditto	1	14	111	7	36	650

Statement No. 3--concluded.

No. of block.	No. of plot.	Name of variety.	Actual area in square yards.	Area cropped in square yards.	DATE OF			ACTUAL OUTPUT.			OUTPUT, PER ACRE.		
					Sowing.	First picking.	Last picking.	Country weight.		English weight.	Country weight.		English weight.
								Maunds.	Seers.		Maunds.	Seers.	
	18c	4 F. ...	1,088	1,084	8th June 1916...	17th October 1916.	23rd December 1916.	1	20	124	6	29	553
	18d	Indicum, 135 A	1,088	972	Ditto	23rd September 1916.	Ditto.	1	8	99	6	0	494
	19c	Local Bhatia	1,088	1,084	Ditto	Ditto.	Ditto.	1	38	162	8	32	724
	19d	Indicum, 135 A	1,088	593	Ditto	Ditto.	Ditto.	0	23	47	4	34	399
	20c	Sanguineum, 20 A	1,088	820	Ditto	9th October 1916	Ditto.	1	0	83	5	39	491
	20d	Indicum, 135 A	1,088	820	Ditto	23rd September 1916.	Ditto.	1	7	96	6	37	571
	21c	Rosea, 87	1,088	976	7th June 1916...	Ditto.	Ditto.	1	34	152	9	8	757
	21d	Indicum, 135 A	1,088	972	Ditto	Ditto.	Ditto.	1	8	99	6	1	496
	22c	Mollisoni, 24	1,088	1,059	Ditto	Ditto.	Ditto.	1	34	152	8	18	695
	22d	Indicum, 135 A	1,088	1,084	Ditto	Ditto.	Ditto.	1	15	113	6	6	507
	23c	Indicum, yellow flowered B. S.	1,088	1,084	Ditto	Ditto.	Ditto.	1	13	110	5	39	498
	23d	Indicum, 135 A	1,088	1,066	Ditto	Ditto.	Ditto.	1	19	121	6	28	552
	24c	Neglectum yellow flowered	1,088	1,066	Ditto	Ditto.	Ditto.	1	29	142	7	34	647
	24d	Indicum, 135 A	1,088	1,084	Ditto	Ditto.	Ditto.	1	16	117	6	14	562
	25c	Neglectum white flowered	1,088	1,084	8th May 1916 ...	2nd September 1916.	Ditto.	2	31	228	12	17	1,022
	25d	Indicum, 135 A	1,088	1,088	Ditto	Ditto.	Ditto.	2	20	207	11	8	923
	26c	Indicum white flowered	1,088	965	Ditto	Ditto.	Ditto.	2	32	230	14	2	1,157
	26d	Indicum, 135 A	1,088	1,013	Ditto	Ditto.	Ditto.	2	23	212	12	12	1,014

Statement No. 4.

SPACING EXPERIMENT WITH 4-F AMERICAN COTTON.

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Name of block and plot	Name of variety.	Actual area in square yards.	Area cropped in square yards.	Spacing in feet given from time to time.	Date of sowing.	Date of first picking.	Date of last picking.	ACTUAL OUTPUT.				OUTTURN PER ACRE.			REMARKS.
								Country weight.	English weight.	Country weight.	English weight.	Country weight.	English weight.	Country weight.	
								Mounds.	Seers.	Mounds.	Seers.	Mounds.	Seers.	Mounds.	
A - 1a	4 F Cotton	2,420	2,420	4'	18th March 1916	23rd September 1916...	23rd December 1916 ...	5	30	11	21	11	21	948	Operations. Before sowing— Bajah plough = 2
A - 1b	Ditto	2,420	2,271	3½'	Ditto	Ditto	Ditto	6	11	13	15	13	15	1,103	Harrowings = 7
A - 2a	Ditto	2,420	2,191	3'	Ditto	Ditto	Ditto	6	11	13	35	13	35	1,142	Sohaging = 3
A - 2b	Ditto	2,420	2,028	2½'	Ditto	Ditto	Ditto	6	8	14	32	14	32	1,219	After sowing— Waterings = 4
A - 3a	Ditto	2,420	2,052	4'	Ditto	Ditto	Ditto	4	39	11	29	11	29	986	Hoings = 6
A - 3b	Ditto	2,420	2,219	3½'	Ditto	Ditto	Ditto	5	35	12	32	12	32	1,054	Average outturn. Md. Sr. 4' spacings .. = 11 25
A - 4a	Ditto	2,420	2,351	3'	Ditto	Ditto	Ditto	6	14	13	3	13	3	1,076	3½' do. .. = 13 4
A - 4b	Ditto	2,420	2,382	2½'	Ditto	Ditto	Ditto	5	35	11	38	11	38	985	3' do. .. = 13 19 2½' do. .. = 13 15

Statement No. 5.

SPACING EXPERIMENTS WITH WHITE FLOWERED INDICUM COTTON, ISOLATED FROM LOCAL BHATLA.

No. of block and plot.	Name of variety.	Actual area in square yards.	Actual area cropped in square yards.	Date of sowing.	Date of first picking.	Date of last picking.	Spacing between the rows.	ACTUAL OUTTURN.			OUTTURN PER ACRE.			REMARKS.
								Country weight.		English weight.	Country weight.		English weight.	
								Maunds.	Seers.	Pounds.	Maunds.	Seers.	Pounds.	
A 19a	White flowered Bhatla selection.	2,420	2,294	7th May 1916	14th September 1916.	7th December 1916.	2½ ft.	3	1	249	(a) 6	15	525	Rajah plough = 1
A 19b	Ditto	2,420	1,956	Ditto	Ditto	Ditto	2 ft.	2	37	241	(b) 7	10	597	Harrow = 1 Sohaga = 2
A 20a	Ditto	2,420	2,312	Ditto	Ditto	Ditto	1½ ft.	4	38	407	10	14	852	Waterings = 3 Hoings = 6
A 20b	Ditto	2,420	2,388	Ditto	Ditto	Ditto	2½ ft.	4	26	388	(c) 9	1	777	
A 21a	Ditto	2,420	2,420	Ditto	Ditto	Ditto	2 ft.	5	6	425	10	13	850	
A 21b	Ditto	2,420	2,420	Ditto	Ditto	Ditto	1½ ft.	5	6	424	10	12	845	

(a) Germination 20% less. If allowance be given the outturn therefore is Mds. 7-24 instead of Mds. 6-15.
 (b) Germination 20% less. If allowance be given the outturn therefore is Mds. 8-28 instead of Mds. 7-10.
 (c) Germination 10% less. If allowance be given the outturn therefore is Mds. 10-15 instead of Mds. 9-18.
 Average outturn per acre after giving allowances mentioned in (a), (b) and (c).

Mds. srs.
 2½ feet spacing ... = 9 4
 2 feet " ... = 9 21
 1½ feet " ... = 10 13

Statement No. 6.

SEED RATE EXPERIMENTS BOTH BROADCAST AND IN LINES WITH WHITE FLOWERED NEGLECTUM DESI COTTON.

No. of block and plot.	Name of variety.	Actual area in square yards.	Area cropped in square yards.	Method of sowing	Seed rate per acre.	DATE OF			ACTUAL OUTPUT.			OUTPUT PER ACRE.		
									Country weight.			English weight.		
						Sowing.	First picking.	Last picking.	Maunds.	Seers.	Pounds.	Maunds.	Seers.	Pounds.
D 3 a *	White flowered neglectum H. A. S. selected.	484	484	In lines	6 Seers	23rd March 1916.	2nd September 1916.	25th November 1916.	1	12	103	13	6	1,074
D 3 a 1	Ditto	484	484	Do.	5 "	Ditto	Ditto	Ditto	1	27	133	16	33	1,384
D 3 a 2	Ditto	484	453	Do.	4 "	Ditto	Ditto	Ditto	0	38	79	10	8	839
D 3 a 3	Ditto	484	418	Do.	3 "	Ditto	Ditto	Ditto	0	31	64	9	2	745
D 3 a 4	Ditto	484	484	Do.	2 "	Ditto	Ditto	Ditto	0	38	79	9	24	790
D 3 b	Ditto	484	426	Broadcast	10 "	Ditto	Ditto	Ditto	1	4	90	12	22	1,082
D 3 b 1	Ditto	484	462	Do.	8 "	Ditto	Ditto	Ditto	1	10	103	13	5	1,073
D 3 b 2	Ditto	484	383	Do.	6 "	Ditto	Ditto	Ditto	0	35	72	10	36	893
D 3 b 3	Ditto	484	484	Do.	5 "	Ditto	Ditto	Ditto	1	1	85	10	16	857
D 3 b 4	Ditto	484	484	Do.	4 "	Ditto	Ditto	Ditto	1	8	100	12	7	1,002

Statement No. 7.

RESULT OF THINNING DESI COTTON AT DIFFERENT TIMES.

No. of block.	No. of plot.	Name of variety.	Actual area, in square yards.	Area cropped in square yards.	Height of the plants when thinned.	DATE OF			ACTUAL OUTTURN.			OUTTURN PER ACRE.		
						Sowing.	First picking.	Last picking.	Country weight.	English weight.		Country weight.	English weight.	
	2 A	White flowered neglectum	...	808	607	9th June 1916	24th October 1916.	8th December 1916.	24	49		4	15	360
P	2 A 1	Do.	...	808	435	Do.	Do.	Do.	19	40		5	21	454
	2 A 2	Do.	...	808	278	Do.	Do.	Do.	8	17		3	24	297

Statement No. 8.

RESULTS OF EARLY AND LATE SOWING OF AMERICAN COTTON WITH DIFFERENT SEED RATES.

Block and plot number.	Name of variety.	Actual area, in square yards.	Sown late or early.	Seed rate, per acre.	DATE OF			ACTUAL OUTTURN.			OUTTURN PER ACRE.			REMARKS.
					Sowing.	First picking.	Last picking.	Country or in English weights.	Country or in English weights.		Country or in English weights.	Country or in English weights.		
								Maunds.	Seers.	Pounds.	Maunds.	Seers.	Pounds.	
E 13 b	...	2,420	Early	6 seers	23rd March 1916.	30th September 1916.	24th December 1916.	3	23	295	7	7	590	Best showing that early sown cotton requires less seed rate.
	Do. ...	2,420	Late	Do.	7th June 1916	25th October 1916.	Do.	1	30	144	3	20	288	
E 14 a	...	2,420	Do.	10 seers	Do.	Do.	Do.	2	20	207	5	1	415	

Statement No. 9.

RESULTS OF GIVING ASH BY BURNING COTTON STICKS.

No. of block and plot.	Name of variety.	Actual area in acres.	Ash given or not.	DATE OF			ACTUAL OUTTURN.			OUTTURN PER ACRE.			REMARKS.
				Sowing.	First picking.	Last picking.	Country weight.		English weight.	Country weight.		English weight.	
							Mounds.	Seers.	Pounds.	Mounds.	Seers.	Pounds.	
15a	Neglectum yellow flowered	1	No ash	8th June 1916	16th October 1916	24th December 1916	1	5	93	4	21	372	
15a 1	H. A. S. selected	1	Ash	Ditto	Ditto	Ditto	1	13	109	5	12	436	
15a 1	Ditto	1	Ash	Ditto	25th October 1916	Ditto	1	0	82	4	1	331	
15a 1	F. American	1	No ash	Ditto	Ditto	Ditto	1	3	89	4	13	356	
15a 1	Ditto	1	No ash	Ditto	Ditto	Ditto	0	36	75	3	26	301	
15a 1	Ditto	1	Ash	Ditto	Ditto	Ditto	1	9	101	4	36	404	
15a 1	Neglectum yellow flowered	1	Ash	Ditto	16th October 1916	Ditto	1	21	126	6	5	504	
15a 1	H. A. S. selected	1	No ash	Ditto	Ditto	Ditto	2	0	164	8	0	658	Much higher yield than other fields due to better soil.

Statement No. 13.

OUTTURN OF PLOT RESERVED PERMANENTLY FOR COTTON AFTER COTTON.

No. of block and plot.	Name of variety.	Area cropped in square yards.	DATE OF			ACTUAL OUTTURN PER ACRE IN 1916-17.			OUTTURN PER ACRE IN 1915-16.		
			Sowing.	First picking.	Last picking.	Country weight.		English weight.	Country weight.		English weight.
						Mounds.	Seers.	Pounds.	Mounds.	Seers.	Pounds.
D	Local Bhatla mixture	4,840	23rd March 1916	1st September 1916	8th December 1916	11	22	950	10	9	838

WHEAT VARIETAL TESTS.

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Kara-sown in lines immediately behind the plough.

Ploughing	...	...
Harrowing	...	...
Solaging	...	...
Hoeing and weeding	...	...
Watering	...	...
Date of sowing,—20th October 1916.		

Statement 12.
WHEAT VARIETAL TESTS.

No. of Block.	Plot.	Name of variety.	Previous crop.	Treatment.	Area sown in acres.	Date of harvest- ing.	ACTUAL OUTTURN						OUTTURN PER ACRE.						REMARKS.
							GRAIN.			BRUSA.			GRAIN.			BRUSA.			
							Country weight.	English weight.	Mounds.	Country weight.	English weight.	Mounds.	Country weight.	English weight.	Mounds.	Country weight.	English weight.	Mounds.	
A	13 c	Punjab type No. 14...	Sugarcane	Sown by	1	12th April 1917	7	28	683	22	12	1,835	30	32	89	8	7,340	Germination fairly good; good stand.	
A	13 d	Pusa No. 12	Ditto	Ditto	1	3rd April 1917...	4	32	394	13	36	1,143	19	8	55	24	4,575	Germination fairly good; fair crop lodged to same extent.	
A	14 c	Punjab type No. 17...	Ditto	Ditto	1	Ditto	6	12	517	20	10	1,666	25	8	81	0	6,699	Germination good; fairly good stand.	
A	14 d	Punjab type No. 11...	Ditto	Ditto	1	10th April 1917	7	39	656	27	9	2,240	31	36	108	36	8,961	Ditto ditto.	
A	15 c	Pusa No. 4	Ditto	Ditto	1	3rd April 1917...	5	28	469	17	27	1,454	22	32	70	28	5,817	Germination fairly good; good stand of crop.	
A	15 d	Punjab type No. 14...	Ditto	Ditto	1	6th April 1917...	7	12	609	27	12	2,246	29	8	109	8	8,985	Ditto ditto.	

Kera=sown in lines immediately behind the plough.

Ploughing
Sowing
Weeding
Harrowing
Hoing
Watering
Date of sowing—19th October 1916.

Statement No. 13.

COMPARATIVE TESTS OF SUGARCANE.

No. of block and plot.	Treatment.	Name of variety.	Date of crushing.	Area in square yards.	Area cropped in square yards.	ACTUAL WEIGHT.												WEIGHT PER ACRE.																				
						COUNTRY AND ENGLISH WEIGHT.																																
						Cane with strip- ped roots.						Stripped canes.						Juice.						Stripped canes.						Juice.						Percentage of juice to cane.	Percentage of juice to gur.	Percentage of gur to cane.
						Munds.	Seers.	Lbs.	Munds.	Seers.	Lbs.	Munds.	Seers.	Lbs.	Munds.	Seers.	Lbs.	Munds.	Seers.	Lbs.	Munds.	Seers.	Lbs.	Munds.	Seers.	Lbs.	Munds.	Seers.	Lbs.									
A	Metha re- moved.	Local lkh ...	11th January 1917 to 15th January 1917.	1,210	970	133	26	10,917	18	0	1,481	95	5	7,827	53	30	4,422	8	33	726	474	26	39,057	361	8	3,623	56.5	16.42	9.27									
A	Ditto ..	Mango of Benares,	21st January 1917 to 26th January 1917.	1,210	1,090	171	27	14,127	20	38	1,713	117	21	9,671	62	31	5,174	9	6	752	521	36	42,945	279	9	3,342	53.5	14.55	7.78									
A	Ditto ..	Suretha Samalkha.	27th December 1916 to 30th December 1916.	1,210	1,040	113	38	9,377	15	13	1,261	93	2	7,656	43	16	3,511	7	38	655	433	1	35,633	201	37	3,649	46.64	18.35	8.56									
A	Ditto ..	Lalri of Samalkha.	4th January 1917 to 8th January 1917.	1,210	1,005	107	26	8,859	13	26	1,123	76	12	6,278	43	16	3,571	7	12	601	369	18	30,401	209	0	2,847	56.8	16.8	9.58									
A	Ditto ..	Dhaura of Azimgarh.	15th January 1917 to 17th January 1917.	1,210	1,020	88	20	7,232	18	13	1,508	53	36	4,435	31	32	2,616	4	27	384	255	30	21,045	150	36	1,325	59	14.7	8.68									
A	Ditto ..	Local lkh ...	20th December 1916 to 23rd December 1916.	1,210	1,090	115	28	4,520	13	30	1,131	80	2	6,587	41	13	3,400	7	21	619	355	18	29,249	183	20	2,749	51.6	18.2	9.4									
A	Metha plough- ed as green manure.	Ditto ...	14th December 1916 to 1st January 1917.	1,210	1,216	202	5	16,632	22	22	1,856	139	5	11,443	79	10	6,532	12	24	1,037	556	20	45,792	317	2	26,069	57	15.9	9.07									
A	Ditto ..	Mango of Benares.	17th January 1917 to 22nd January 1917.	1,210	1,210	200	31	16,521	27	14	2,250	139	31	11,501	80	15	6,615	11	24	955	559	4	46,006	321	22	26,459	57.5	14.5	8.3									
A	Ditto ..	Suretha of Samalkha.	24th December 1916 to 27th December 1916.	1,210	1,210	204	29	16,846	20	36	1,719	144	2	11,853	81	11	6,687	14	0	1,152	576	8	47,414	325	4	4,608	56.4	17.2	9.7*									
A	Ditto ..	Lalri of Samalkha.	8th January 1917 to 12th January 1917.	1,210	1,210	207	31	17,097	22	10	1,831	147	19	12,135	87	0	7,159	12	38	1,065	589	36	48,782	348	0	28,636	58.9	14.88	8.8									
A	Ditto ..	Dhaura of Azimgarh.	12th January 1917 to 15th January 1917.	1,210	1,210	111	1	9,135	19	8	1,680	74	15	6,121	36	29	3,022	6	17	528	297	22	24,484	146	36	12,088	49.37	17.5	8.64									
A	Ditto ..	Local lkh ...	18th December 1916 to 20th December 1916.	1,210	1,210	104	29	8,617	12	2	991	74	20	6,130	39	21	3,252	7	11	599	298	0	24,521	158	4	13,003	53	18.4	9.78									

*Best.

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for 1917-18.**

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REPORT

ON THE OPERATIONS OF THE

DEPARTMENT OF AGRICULTURE, PUNJAB,

FOR THE YEAR ENDING 30TH JUNE 1918.



Lahore :

PRINTED BY THE SUPERINTENDENT, GOVERNMENT PRINTING PUNJAB.
1918.

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*Proceedings of His Honour the Lieutenant-Governor of the Punjab in the
Department of Revenue and Agriculture—Agriculture, No. 23094,
dated 16th December 1918.*

READ—

A Letter No. 49150-F. 2, dated the 2nd December 1918, from the Junior Secretary to the Financial Commissioner, Punjab, forwarding, with the remarks of the Financial Commissioners, the Annual Report on the Operations of the Department of Agriculture in the Punjab for the year ending 30th June 1918.

THE salient points in the working of the Agricultural Department during the year have been well brought out in the Financial Commissioner's note. Progress, though still handicapped by inadequate staff, has been continuous, and the separation of the Department of Industry from the Director's charge should ensure more thorough supervision and control in the future. Owing to the war no increase in the superior expert staff has been possible, but since the year closed sanction has been accorded to an addition of 15 Agricultural Assistants, as qualified men become available, to the cadre to provide for the more urgent needs of the department, and to enable it to expand its activities outside the central and colony districts to which they have hitherto been mainly confined. The call of the department for increased staff both in the superior and the lower grades of the service is, however, likely to continue for many years. The allotment of Rs. 11,67,000 made to this Province out of the wheat profits has brought the realisation of many new agricultural projects closer, and future reports should set forth clearly, for the information of the Local Government and the Government of India, the progress made with the various sanctioned schemes and also of the measures taken for the utilization of the recent grant of Rs. 4,69,000 made by the Government of India for agricultural education. Clearly there is no lack either of funds or of suitable objects for expenditure, and it is for the department to utilise the opportunities at its disposal as rapidly as the special difficulties created by the war allow.

2. The number of applicants for admission to the Lyallpur Agricultural College during the year was 223 compared with 202 in 1917, while the number admitted as last year was 38. For the vernacular class there were 101 applications and 37 admissions. There is room, as stated last year, for a second vernacular course, but the more immediate necessity at Lyallpur for a class for vernacular school teachers has been given precedence. The Lieutenant-Governor has, however, sanctioned the construction of a sarai at Gurdaspur which can accommodate the students, and as soon as this is ready and a teacher can be provided a second class will be instituted there. The affiliation of the College to the Punjab University and the remodelling of the curriculum took effect from the year under review, and in connection therewith the staff was strengthened considerably. Given a strong Agricultural Faculty in the University, the Lieutenant-Governor endorses Mr. Maynard's opinion that the efficiency of the College as a place of instruction in practical agriculture will in no way be endangered by the changes that have been introduced, and that candidates for admission to the College are likely to be attracted from a wider field than hitherto. The examination results of the year were remarkably good, none of the students having failed to pass and nearly a quarter of the total having been placed in the first class. The success of the College as of the department generally will mainly depend on the extent to which it commands the confidence and enlists the co-operation of the agricultural community. In recent years it has secured both in an increasing degree. One evidence of this is the increasing desire of the large landholders to complete their education in the College, another is the demand among the same class for men who have graduated in the College. It is, however, important to secure that those admitted to the College should be mainly drawn from the landholders' classes, and in future reports figures should be given to show how far this result is being attained.

3. A block of 625 acres in the Ganji Bar (Montgomery District) has now been allotted for the experimental station sanctioned for research work on various types of sterile soil on the Lower Bari Doab Canal. A further area of 1,000 acres has been selected for the trial of the methods proposed by the late Mr. Barnes, while other plots have been assigned for the trial of reclamation by bullock power. Laboratory investigation of the soils included in the experimental block has been begun, but no very definite results can yet be announced. His Honour agrees with the Financial Commissioners that the duration of the cure of alkaline lands at Narwala is a question to which reference in future reports is desirable. Problems connected with water saving are receiving considerable attention at Lyallpur and elsewhere, and some interesting results have been revealed by experiments to test the comparative effects of several waterings in the case of various crops. An impetus will be given to the investigation of these problems by the establishment of a farm at Roda Koru for their scientific study. This again is a problem that must be deferred until another Deputy Director is added to the cadre. If it can be established that wheat, barley and oilseeds thrive better with two than with three waterings after sowing, that result would do much to solve the difficulties of canal supply, and the Lieutenant-Governor does not share the Director's doubts as to being able to find a profitable use for the water so saved. The Irrigation Branch will have no difficulty in solving that problem.

4. The ever-increasing popularity of American 4-F cotton is evidenced by the figures given in paragraph 13 of the report. The total area in the colonies under this cotton was 390,000 acres, an increase of more than 81 per cent. on the previous year. In the Lower Bari Doab Colony the area more than doubled. The great benefits reaped by Punjab agriculturists from the spread of this variety would in itself fully justify all the expenditure of the Department up-to-date. At a very moderate valuation the extra gain to the producer in the present year is at least 60 lakhs of rupees. The Lieutenant-Governor is glad to observe that the maintenance of the purity of this variety is receiving close attention. The area under Punjab 11 wheat has risen from 97,000 to 196,480 acres during the year; it is understood that some 200 maunds of Mr. Milne's new selection are being distributed this year. Mr. Milne's statement of the superiority in the matter of yield of the variety known as 8-A receives strong corroboration from many sources, and if its value for milling purposes is also established, the Department will doubtless push this variety on a larger scale.

5. In connexion with cotton sales it is satisfactory to learn that the posting of Bombay prices at 18 markets assisted the growers in securing the full value of the crop. The transfer to certain Co-operative Societies of some of these cotton sales was recently noticed by the Lieutenant-Governor in the review of the work of the Co-operative Department, and His Honour agrees with the Director that the work is a more legitimate occupation for such societies where they exist or can be established than for the Agricultural Department.

6. High prices and difficulties in obtaining material have hampered the work of the Agricultural Engineer during the year, and there has been some decrease in the amount of well work accomplished. There is a vast field for experiment especially in the districts which have no canal irrigation, and the Lieutenant-Governor trusts that as the temporary difficulties created by the war disappear, this important work will receive the attention it deserves. The sale of imported implements underwent a large decrease during the year owing partly to restrictions on import but mainly to the advance in prices.

7. The movement for the creation of demonstration farms is taking a firm hold in many districts, and its further development only awaits an increase in the supply of qualified managers. Demonstration plots on a small scale are being started in the Gurdaspur and Jullundur Districts by members of Co-operative Societies, and their multiplication is likely to have a far-reaching effect on the spread of improved methods of agriculture. An interesting innovation of the past year has been the organisation of itinerating parties for the purpose of conducting exhibitions of improved implements in outlying villages.

8. The reports of the Principal, Agricultural College, and of the various expert officers of the Department which appear in the appendices are most interesting reading. Some of these officers complain of being restricted in the matter of space, while others have perhaps taken more than the importance of the subject matter demands. The Financial Commissioner might, perhaps, in consultation with the Director, reconsider the various limits fixed, making it clear that while Government in no way desires to damp the enthusiasm of officers engaged on such engrossing and important investigations, their annual reports are intended to be a summary of the results of their work and not a medium for controversial discussion.

9. Sir Michael O'Dwyer took occasion last year to express his appreciation of the services of Mr. Townsend, as Director of Agriculture, and need only add that the experience of another year confirms the value of the work done by him and the experts of the Department, of whom Mr. Roberts and Mr. Milne, in particular, have done work of great value to the Province. The great success achieved by the Department in recent years is largely due, as pointed out in paragraph 18 of the report, to the cordial relations with the officers of and workers in allied departments, and future progress will depend not only on the maintenance of those relations, but on close and friendly co-operation and unity of purpose within the Department itself.

ORDER.—Ordered that a copy of these remarks be forwarded to the Senior Secretary to the Financial Commissioners, Punjab, for the information of the Financial Commissioners, that they be published in the *Punjab Gazette*, and submitted with copies of the report to the Government of India in the Department of Revenue and Agriculture.

By order of His Honour the Lieutenant-Governor of the Punjab,

E. JOSEPH,

Offg. Revenue Secretary to Government, Punjab.

No. 491-50-F-2.

FINANCIAL COMMISSIONERS' OFFICE :

Dated Lahore, 2nd December 1918.

FROM

W. R. PEARCE, Esq.,

Junior Secretary to the Financial Commissioners,

Punjab,

TO

E. JOSEPH, Esq., I.C.S.,

Offg. Revenue Secretary to Government, Punjab.

The Hon'ble Mr. H. J. Maynard, C.S.I., I.C.S.

SIR,

In continuation of this office letter No. 491-50-F-1, dated 28th November 1918, I am directed to forward a note containing the Financial Commissioner's remarks on the Annual Report on the Operations of the Department of Agriculture, Punjab, for 1917-18.

I have the honour to be,

SIR,

Your most obedient servant,

W. R. PEARCE,

Junior Secretary to the Financial Commissioners, Punjab.

Financial Commissioner's note on the report of the Agricultural Department for 1917-18.

1. The prominent features of the past year's record of the work of the Agricultural Department are the pressure for further development of the work, and the difficulties in the way of meeting that demand. The difficulties are partly the result of the war in making impossible the expansion of the superior expert staff, in increasing the demand for the services of the qualified Agricultural Assistants, notably for Mesopotamia, and in preventing the supply of material or greatly raising the price of it. They are partly also the result of the short supply of Agricultural Assistants, due to the small outturn of qualified men during the period in which the applications for admission to the Agricultural College fell off. This last deficiency will tend steadily to correct itself, as the large number of applicants to the College (223 for 53 vacancies) sufficiently indicates. But war conditions, in respect to the supply of superior staff, the scarcity of material, and their high prices, must be expected to affect the activities of the Department throughout the present year.

2. The Agricultural College, now an affiliated college of the Punjab University, with a revised curriculum and a staff already somewhat strengthened to meet the requirements of University advisers having a wide experience of teaching, offers to students the bait of an Agricultural Degree, and should attract applicants from a wider field. Mr. Maynard does not feel any apprehension that these changes will imperil the efficiency of the College, as a place of instruction in practical Agriculture. On the contrary the exercise of the University's influence through the medium of a strong Agricultural Faculty including teachers in the College itself as well as teachers of Science in other colleges, must necessarily be beneficial. Examination results are excellent except in Entomology. It is satisfactory to find that eight students of the large land-holding class or from the Aitchison Chiefs' College have been admitted for the session, 1918-19. Six of these are candidates for the full degree course. Two students from the province of Sindh have also, it is noticed, been admitted. The contribution to the general agricultural education of the Province, which may be expected from the Lyallpur College, is shown by the decision to establish a class for Vernacular School teachers there. An even more important project is that for the location of a new Central Training College in close proximity, so that students of teaching will have the benefit of the experimental farm and the lectures given by the Agricultural College staff. The Financial Commissioner regrets that it should be necessary to start a vernacular class at Gurdaspur where teaching equipment and facilities are necessarily smaller than at Lyallpur; but he recognises that the instruction of teachers must take precedence, and that the arrangement made was the inevitable one.

3. The reclamation of barren land in the Lower Bari Doab Colony is one of the important works which is held back by the lack of adequate superior staff. The institution of an experimental farm, ultimately, it is hoped, to become the head-quarters of a reclamation circle under the control of a Deputy Director, has been sanctioned by Government and laboratory investigation has been commenced by the Agricultural Chemist. The Financial Commissioner notices with interest that one of the methods being tried for the investigation of the deflocculated nature of the clay in *bara* land is an electrical method. The report of the Professor of Agriculture contained in Appendix VI to the annual report deals with district work in the Chenab Colony: but makes no reference to the important question of the duration of the cure of alkaline lands at Narwala. In dealing with the report for 1916-17 the Financial Commissioner remarked that a careful record of each season's crops ought to be kept after inspection by the Deputy Director of Agriculture: since on the duration of the cure depend important deductions regarding the efficacy and financial value of similar measures elsewhere. To these remarks he now adds that the matter is one which should receive notice in the annual reports.

4. 4-F. cotton—a selection of Mr. Milne's—continues to make headway in the colonies, the area which it occupies being 390,000 acres against 215,000 in the preceding year. Punjab-11 wheat has more than doubled its area in the colonies in the year under report, but Pusa 12 is more popular in the well-irrigated tracts of Hoshiarpur, Jullundur and Sialkot. There is no finality

about any of these selections, and the willingness of the Department to push the best, whatever its origin, is a wholesome sign. There are indications that Mr. Milne's 8-A wheat may prove as good as Punjab 11 or even better : but what is the best in one tract is not necessarily best in another, and it has to be realised that the work of the Agricultural Department is not yet distributed with an equal intensiveness over the whole of the Province.

5. Mr. Roberts has described in the section of his report dealing with cotton seed farms the precautions which are taken to keep the seed pure. The Financial Commissioner trusts that the Economic Botanist's apprehension that these measures will not avert deterioration, will not be borne out by facts. The warning deserves respectful attention but the Financial Commissioner does not accept the inference that it is the work of a specialist to keep the improved types pure.

6. The formation of Cotton Sale Associations, which may be hoped in course of time to establish a commercial reputation for the quality of their cotton, marks the beginning of a movement that is likely to be of great benefit. The question of the lease of land for cotton growing to the British Cotton Growing Association is still in suspense, because it is uncertain to what extent the encouragement of cotton growing within the Empire will be taken up by the Government of the United Kingdom. It is understood, however, that the Committee of the British Cotton Growing Association retains a lively interest in the project, though it will ask for a modification of certain of the terms. The advantage expected from the intervention of the British Cotton Growing Association in Punjab cotton growing, is that it will introduce Punjab American cotton direct to the British market, and facilitate the securing of adequate prices for the pure article.

7. In paragraph 6 of his remarks on the preceding year's report, Mr. Maynard drew attention to the desirability of exhibiting the financial results of manurial experiments at the Lyallpur, as at the Gurdaspur farm. This has been overlooked. As the Director has remarked some of the most important experiments in progress are those for the ascertainment of the best times and amounts of irrigation. It is certain that much canal water has been wasted in the present, to the detriment of the public health and without advantage to agriculture (or even to its detriment) : and the question is one of vast economic and hygienic importance.

8. The work of the Agricultural Engineer has been seriously affected by the unfavourable conditions which have prevailed, and there is a reduction in the well work done in the province. The construction of a properly equipped workshop at Lyallpur has been agreed upon in principle but held over by reason of war prices and shortness of material. The Financial Commissioner notices that the sample grain bin of reinforced concrete constructed by Mr. Miller Brownlie at Lyallpur has led to the manufacture of 3 maund bins of this material, at a cost considerably less than that of iron bins.

9. The enquiries into the management of municipal sewage farms in which the Lyallpur experts recently co-operated with the Sanitary Board have led to the designing of experiments by Mr. Wilsdon, the Agricultural Chemist, into the most economical methods of applying sullage to agricultural land, and land has been placed at his disposal for this purpose by the Lyallpur Municipality.

10. The most important change in the Department during the year under report has been the division of the charge of Agriculture from that of Industries. Mr. Townsend, who has been Director of Agriculture for 4 years, has become Director of Civil Supplies, retaining the charge of Industries, and giving up that of Agriculture. Mr. Maynard has on previous occasions expressed his high appreciation of Mr. Townsend's work, and he now has to add his regret that Mr. Townsend is lost to the Department. He feels that a progressive department such as Agriculture could hardly have found a better head, and that a debt of gratitude is due to Mr. Townsend for the smoothness of the relations maintained and for the marked successes achieved during the past years.

LAHORE :

W. R. PEARCE,

The 29th November 1918.

*Junior Secretary to the Financial
Commissioners, Punjab.*

Annual Report

ON THE

Department of Agriculture, Punjab,

FOR THE YEAR ENDING 30th JUNE 1918.

1. Toward the close of the year under report the Department of Agriculture and Industry was divided under two Directors, Mr. Townsend whose work had become excessive owing to the growth of the department and the additional charge of the Directorship of Civil Supplies retaining charge of Industries while I was appointed Director of Agriculture.

Staff.

Mr. Roberts was on deputation with the Indian Cotton Committee on two occasions aggregating between 6 and 7 months, when Mr. Wilsdon acted as Principal of the College. Maulvi Fateh-ud-din continued to officiate as Deputy Director at Gurdaspur in the room of Mr. Southern whose death long feared has now been officially announced. Mr. Faulkner has continued at Lyallpur assisting Mr. Roberts as associate professor and assistant in district work. Three new assistant professors and 3 demonstrators have been added to the staff owing to the affiliation of the College to the University.

2. Principal Roberts' report (appendix I) shows a remarkable record of satisfactory work. The year opened with 82 students on the roll, 38 and 34 in the first and second years, 4 in the third and 6 in the fourth year. The Rural Economy class could not be held owing to the Principal's absence, but the vernacular class was held as usual, while arrangements have been made for opening a new class for selected vernacular middle school teachers, who may be able on their return to their schools to impart to their pupils something of the spirit and practice of modern agricultural science. The class actually opened immediately after the close of the year under report, but it is permissible to add that the Principal is sanguine regarding its results and that I found these teachers, when I visited Lyallpur in July last and saw them at work on the farm, themselves keenly interested in the experiment. The examination results are remarkable, cent. per cent. of the candidates being passed while nearly a quarter of the total number were placed in the first class. Except in the matter of entomology in which the external examiner (Mr. Howlett of Pusa) criticised the results very unfavourably, the reports of the examiners were much to the credit of the teaching. Mr. Howlett's stand-point is not perhaps identical with that adopted at Lyallpur, but efforts are being made to remedy certain admitted defects.

The Agricultural College.

A second vernacular class will be started at Gurdaspur as soon as the staff is available for conducting it and meantime arrangements are being set on foot for erecting a sarai there on whose accommodation the vernacular students will have first claim, while visitors to the experimental farm will also be able to obtain much needed accommodation in it. The question of staff, both superior and inferior, is one which limits the expansion of the department's energies at every turn. More deputy and assistant directors are needed and until we can expand our cadre of agricultural assistants (at present the sanctioned scale is below strength) it is impossible to develop District Board farms or expand further in any direction. This is a point which has to be borne in mind in dealing with applications for assistance from outside the province, whether from Mesopotamia, from Native States or elsewhere.

The new quarters for the students from the Chiefs College are now built and occupied, but a large building programme consequent on the expansion of the college must be faced in the near future. Accommodation for

assistant professors, for subordinate staff, and for teachers class has to be found and enlargement of the students' farm buildings and of the laboratories is essential. It is also proposed to locate a new Central Training College in close proximity to and connexion with the Agricultural College, but the funds for this will be asked for by the Education Department.

3. The Agricultural Chemist's report forms appendix II. Mr. Wilsdon has brought marked ability and enthusiasm to bear on the many important problems that await solution. The various problems reported in progress last year continue to receive attention, while arrangements are in train to start work on the Bara Experimental Station near Montgomery. Here again paucity of staff has impeded progress. There has been great difficulty in finding a capable agricultural assistant for the supervision of the work, which though it involves problems which can only be solved with the aid of chemistry would not naturally be placed in the Chemist's immediate charge.

4. The Economic Botanist's report (appendix III) contains controversial matter that is not suited to an annual report of work done. It has already been returned for curtailment of its length, but Mr. Milne has pointed out that it is within the old limit prescribed (which was reduced very late in the day) and has professed himself unable to convey his remarks clearly in fewer words. Though not sharing this inability I have printed the report as it stands.

Mr. Milne has continued to work with energy in the field of economic botany in which he has already laboured with marked success in the past. In the matter of cottons his evidence before the Cotton Committee is public property, but it is not advisable to comment on it in anticipation of the publication of the Committee's report. He is afraid that the cotton now known as 4 F may deteriorate from the strain originally isolated. The maintenance of the purity of any successful variety is undoubtedly a problem as important as the evolution or isolation of a new variety better than that commonly grown. In this connexion attention may be invited to what is said by Mr. Roberts in his report as to the measures adopted on the farm for the maintenance of the standard by which the district is practically restocked every fourth year.

In wheats there seems reason to think that S-A. may oust Punjab-11, and it will be seen that Mr. Roberts is now prepared to give the seed out to zamindars. Mr. Milne's researches on ear-cockle in wheat have brought him to the conclusion that with clean seed the disease can be at once eradicated. Mr. Milne has written an illustrated monograph for publication and I have asked him also to prepare a brief leaflet for free distribution to farmers. Publication of his book on date palms has been unfortunately delayed owing to some difficulty with the illustrations.

5. Appendix IV contains the report of the Assistant Professor of Entomology. A separate report on the treatment of mango trees for prevention of attack by the monophlebus has been submitted to Government, and it is proposed next year to continue the experiment in a private garden of good variety mangoes. Sericulture work has further expanded during the year, 921 ounces of seed being distributed by the department alone as against 700 last year, and owing to the high price that silk now fetches the rearer realised on an average Rs. 21-1-0 against Rs. 15-11-0 in the preceding year, per ounce. We have now reached the stage when if sericulture is to be established as a cottage industry in the province a separate staff must be entertained, as the Assistant Professor of Entomology cannot spare the time from his legitimate duties, and on this question I shall shortly address the Financial Commissioners separately. The real crux of the situation lies to my mind in the provision of mulberry, towards which but very slow progress has at present been made. The rearer, who has hitherto enjoyed the right of taking leaves free of cost—is ordinarily a landless man. Neither the landowner nor the District Board is going to put money into mulberries for the benefit of the menial. If sericulture is to be a commercial proposition there must be a margin of profit for the mulberry grower and we shall have to see whether the rearer will care to keep worms when he has to pay the economic price of the leaf.

Sericulture in schools is a vexed question, and has been gradually abandoned. The District Inspector usually prefers the production of the book-worm to that of the silk-worm. The Director of Public Instruction is however strongly impressed with the practical and educative value of the latter and steps are being taken in co-operation with him to restore this branch of the work.

6. The Agricultural Engineer's report will be found in Appendix V.

Agricultural Engineering.

Advancing prices, increasing difficulty of obtaining material, restriction of goods traffic and the demands of Mesopotamia have all contributed to a reduction of the well work done in the province during the past year. Though the number of borings sank to 337 or 9 below the total of the penultimate year, it is satisfactory that the percentage of success rose to 74.4 or 4.1 higher than in the year immediately preceding that under report. I am less satisfied with our success in estimating the cost of tube well installations and am considering whether anything can be done to render our estimates more reliable.

Much useful work has been done by Mr. Brownlie in connection with designing agricultural implements, etc., and we are now manufacturing 3-maund capacity grain bins of reinforced concrete at a much lower cost than the Public Works Department could supply us with iron bins.

7. There is nothing of special moment to report and as paper is to be

Poultry, bees and olives.

economised I omit reference to these matters this year, but would note that Mr. Cousins' appointment as apiarist has terminated and that the Forest Department, to which the olive plantation has been transferred, hopes to have some progress to report next year. It is dealing energetically with the plantation.

8. There has been a great decrease in the sale of imported agricultural implements of which only 725 were sold in the past year.

Implements.

Name of implement.	Sold in 1916-17.	Sold in 1917-18.
Rajah plough	... 379	63
Meston plough	... 1,264	557
Other ploughs	... 92	41
Hoes	... 10	10
Harrows	... 56	30
Fodder cutters	... 42	11
Miscellaneous	... 20	18
Total	... 1,863	725

Owing to restrictions on import of machinery some implements have been difficult to obtain, but the decrease in sales is due primarily to the great advance in prices. On the other hand, 306 bar harrows manufactured at Lyallpur and sold below cost price, 132 Lyallpur drills and 59 Lyallpur hoes, have been disposed of. I noticed that some of the wood work of the bar harrows in stock at Gurdaspur was not seasoned, and was attacked by borers, but steps are being taken to secure a supply of seasoned shisham for their manufacture. These harrows are now being used with success on cotton and toria, though originally designed for wheat. Messrs. Brownlie and Faulkner are occupied in evolving a type of hoe on the lines of the Planet Junior and Mr. Roberts has an improvement on the Rajah plough in hand.

9. Appendix VI contains Mr. Roberts' report on the agricultural

Lyallpur Farm.

section of the Lyallpur Farm and his district work. The most important result in the wheat work is to confirm the conjecture that in Mr. Milne's selection 8-A we have a wheat which may displace Punjab-11, and it will be interesting to see whether in the coming rabi it displaces the latter in popularity with those zamindars to whom it is distributed. The experiments with Pusa-12 and Punjab-11 do not bear out the suggestion in last year's report that the former will do with less

water than the latter. They merely show that there is no benefit in Pusa-12 if two waterings are available (and there is the notorious drawback that birds attack it more readily) while if a third watering is procurable Punjab-11 responds to the additional irrigation much more than its rival.

The advantage of line-sowing over broadcast with cotton, owing to the facility of interculture, has been amply demonstrated and the practice is now being widely and increasingly adopted by zamindars.

The experiments in saving water in cotton fields in May and June are very important. They were somewhat obscured by the unusual rainfall of last year and deserve the further prosecution which they are receiving. From what I saw during the present dry year in July (when conditions were aggravated by poor germination following on last year's excessive rainfall) I am inclined to think that a satisfactory solution of the problem will be reached, but it must of course be recognised that water saving will involve better cultivation and more labour. There are indications too that both in the case of wheat and toria water can be saved, but the problem of finding a profitable use for any water so saved has not yet been solved.

10. The work of the Gurdaspur Experimental Farm is narrated in appendix VII. Maulvi Fateh-ud-din's remarks on the climatic conditions of the year form an interesting illustration of the well-known fact that distribution of rainfall is of far more moment than its total volume. Varietal experiments with wheat tend to confirm the merits of 8-A, but the Deputy Director is wisely cautious in accepting conclusions. The manurial experiments have been continued but have not yet given any positive results. Among minor crops the test with groundnuts deserves attention. The expenses of cultivation have not been mentioned, but if the average produce maintains the value of anything like Rs. 72 the acre, it is likely to become a popular crop. The new land at Gurdaspur has been very well cleared and was being prepared for chari when I saw it in June.

A part of the Sargodha Seed Farm has now been laid out for experimental work, the main lines of research conducted being varietal wheat and cotton tests and water saving experiments in wheat on the lines of Mr. Howard's work at Quetta (see appendix VII-a). None of the experiments done last year can be considered as conclusive, but it is interesting to note that here as elsewhere 8-A wheat which was tested against four other new selections and Pusa-12, with Punjab-11 as the standard, gave excellent results.

11. Sardar Darshan Singh's work on the Hansi Farm is summarised in Appendix VIII. The value of the experiments conducted here suffers from the inequality, and at many points the inferiority of the soil, and it will take some time to bring it to a sufficiently uniform standard. The abnormal rainfall conditions of the year further obscured results. The plant to plant selection among desi cottons is an interesting line of work but at present very far from complete. 58 rows were grown this year from 58 plants selected last year for their ginning percentage of over 35 (maximum percentage of any one plant 43.5). From these 58 rows 38 plants have been kept for next year's seed, with a ginning percentage of over 41 (maximum of any one plant 47). Sardar Darshan Singh is of opinion that further improvement is possible but it has yet to be proved that selection will give a variety whose lint percentage comes true: and we need, I think, to watch the effect of a high lintage on the fertility of the seed. Here as elsewhere 8-A did best in the varietal wheat tests. The outturns of barani wheat (Punjab-14) are remarkable, but climatic conditions at sowing time were peculiar. The ensilage experiments are noteworthy; these are being continued.

12. It has been decided to start a farm at Roda Koru for the scientific study of the many problems connected with "agricultural hydraulics," but it is impossible to initiate this in the immediate future for lack of staff. Meantime at Lyallpur and elsewhere many of these problems are receiving attention, not the least important among them being the optimum times and amounts of irrigation. At Lyallpur there is definite evidence that the third watering after sowing (whether or no

any other use could be made of the water then available) reduces the outturn of wheat by 10 or 12 per cent. It would be well if the dates of irrigation and rainfall data were in future incorporated in these statements. At Sargodha wheat not watered after sowing gave close on 15 maunds per acre while the district average on the canal tract is put at rather less than 10 maunds, but this result must be received with considerable caution. It is proposed to attempt some further experiments in zamindars' fields in the Lower Jhelum Canal. Rai Sahib Lala Sewak Ram tried some experiments at Gangapur on Pusa-12. He experimented with two, one and no waterings after sowing, so that we have here no evidence as to the deleterious effect of a third watering. As in the previous year the best results were obtained with two waterings, the outturn being $27\frac{1}{2}$ maunds per acre. One watering gave 24 maunds. These results do not differ very materially from those obtained the year before, but a greatly larger outturn ($19\frac{1}{2}$ maunds) was obtained with no watering; the rainfall conditions were very suitable however. In the case of toria with which similar experiments were tried at Lyallpur a second watering appeared to diminish the yield in the early sown crop by a maund, but it increased the yield by $1\frac{1}{4}$ maund in the case of late sowings.

13. Mr. Townsend showed graphically in paragraph 16 of last year's report the remarkable development of 4-F cotton throughout the colonies. The figures this year (in acres) are quite as remarkable, for it is obvious that the same geometric ratio of increase cannot be expected to persist—

	1917.	1918.
Lower Chenab Colony ...	120,000	190,000
Lower Jhelum Colony ...	11,500	16,000
Lower Bari Doab Colony ...	80,000	173,000
Chunian Colony, &c. ...	3,500	10,000
Upper Jhelum Colony ...	..	1,000
Total ...	215,000	390,000

Mr. Roberts estimates that 80 per cent. is practically pure 4-F. The growth on the Lower Bari Doab Colony is specially remarkable and I look forward to seeing this colony the cotton colony par excellence of the province as the Lower Chenab Colony is the prime wheat tract.

14. Mr. Roberts' notes on cotton sales are interesting. The inauguration of private sales is a most gratifying feature, for the cotton auction work occupies in the season a great deal of the time of the staff and is work which, however necessary at the start, is hardly a legitimate occupation for the department. I am hoping in co-operation with the Registrar of the Co-operative Credit Societies to hand over one of our sales this autumn as an experiment to one of his cotton sale societies. It will be necessary in the first instance to lend the society the services of a grader, but I look forward to the time when societies of this nature will have their own skilled graders whose hall mark will be accepted by the trade as a sufficient guarantee of standard. Bombay cotton prices were posted at 18 markets. The information thus published appears to have facilitated the securing of the full value of the crop and the experiment will be repeated this year, but this too, if commercially justified at all, is an item of expenditure which should ultimately be taken over by the societies who profit by it. The Okara Zamindars' Society, to which Mr. Roberts alludes, issued an interesting report in print under the signatures of Colonel Cole and Major Vanrenen on their auction of January 22nd when some 18,500 maunds of pure 4-F were sold. This publication is an interesting example of the value of the new movement, which is capable of becoming a potent force for good in the country side as well as for the profit of the producer. Mr. Roberts' remarks on the provision of wagons for shifting this winter's cotton crop merit attention. I have already brought the matter to the notice of the Director of Civil Supplies. The option on the 7,500 acres of land at Khanewal which was given to the British

Cotton Growing Association will expire on the 30th September and a reply is awaited from Mr. Hodgkinson who after his visit to India undertook to discuss the matter further with the Association of which he is a member.

15. The area under pure Punjab-11 wheat is estimated to have more than doubled itself in the year under report, the figures conjectured are in acres—

District work. Wheat.

		1917.	1918.
Lower Chenab Canal	...	60,000	100,000
Lower Jhelum Canal	...	22,000	45,000
Lower Bari Doab Canal	...	15,000	50,000
Upper Jhelum Canal	...	...	1,480
Total	...	97,000	196,480

while Mr. Roberts estimates at least another 750,000 acres with not more than 10 per cent. impurity. A lakh and-a-half of rupees has been advanced for the purchase of seed for the coming season, apart from what is stored by the people themselves through the agency of the department. Of the future of 8-A I have already spoken. In Hoshiarpur, Jullundur and Sialkot Pusa-12 continues to be the most popular wheat and is spreading. Mr. Peake, proprietor of the Solon Brewery, has been popularising this wheat in Sirmur and the Simla Hills. In the Hariana tract opinion is reported to be divided, but on the whole Pusa-12 seems to be preferred for well lands and Punjab-11 for canal irrigation.

16. There can be no doubt that interest and belief in the activities of the department gain ground annually. There is a more live tone in the proceedings of agricultural associations and a keener realisation of the possibilities of agricultural advance on co-operative lines. In this connexion it is interesting to note that a research scholarship has been awarded to the best student of the year, Chanda Singh, and that the subject selected for study is "Co-operative credit in its relation to agricultural development." His studies will be directed partly by Mr. Roberts and partly by Mr. Calvert and the period spent in research should prove stimulating and fruitful of results.

District Boards, aided in initial outlay by grants from the wheat profits are coming forward with proposals for demonstration farms. I have succeeded—not without weakening staff elsewhere—in finding one agricultural assistant for the Rohtak farm, but at Amritsar, Sialkot, Ludhiana, Jullundur, Mianwali, Gujranwala, Ambala and Karnal the development of these farms is in abeyance owing to the inability to find assistants, a lack which has also prevented work on the rice farm on the Upper Chenab Canal from being started, though the land has been acquired. District work could be extended in many promising fields, were men available. A useful line of advance is the provision of small demonstration plots which are being started in Gurdaspur and Montgomery to be worked through co-operative credit societies by the zamindars themselves under the guidance of the agricultural assistant of the district. Successful adoption of new methods by the zamindar himself carries conviction to the mind of his brother farmers quicker than its demonstration on a Government farm. Similarly short loans of agricultural implements to the people themselves are more productive of results than demonstrations at fairs, though the latter method was also adopted. In the Gurdaspur circle about 614 implements were lent out in the year. Another method of popularising these novelties has been adopted in sending itinerating parties through the villages to work them.

17. Amongst minor crops to which attention has been paid are millets, Japan sarson and potatoes. Owing to the heavy rain of the last year jowar seed was procurable with the greatest difficulty. Aid was given by sending an agricultural assistant to Hoti Mardan to purchase good seed. The "Australian bajra" has

Minor crops.

become very popular in the Gurdaspur circle and the Deputy Director of Agriculture is now separating and testing comparatively the mixed strains contained in it. The Deputy Director of Agriculture, Hansi, notes that it is attracting attention in Ferozepore and Kaithal, and that it suits heavy irrigated soils. The growth of Scotch potatoes continues to expand in the Simla Hills, their yield being quite double that of the old variety. Potatoes are an important crop in Sialkot. The department undertook with some success to demonstrate the storage of seed in sand as protection against the rot caused by the havoc of a moth. Unfortunately the treatment has not been effective against the *Rhizoctonia* fungus which has caused widespread destruction of the seed crop this year. Attention is being directed by leaflet and otherwise to the value of castor as a crop.

18. The need for economy in paper and the slightness of my present acquaintance with the activities of the department have induced me to shorten this report. I have however seen enough in the short time since I took charge to appreciate the good work unobtrusively done by the officers of the department, English and Indian alike, and also by the subordinate staff. Mr. Calvert, Registrar of Co-operative Credit Societies and his joint registrars, Messrs. Darling and Strickland with their staffs are enthusiastic helpers. The Deputy Director at Gurdaspur is indebted to Mr. Estcourt, Deputy Commissioner, for the keen interest taken in the work of the farm. Special mention has been made in the Lyallpur report of the assistance rendered in every aspect of the department's work by Mr. Kitchin, late Deputy Commissioner of Lyallpur, while the Assistant Director at Montgomery desires to acknowledge the help uniformly given by the late Mr. R. D. Thomson, Colonization Officer, and Mr. Henriques, Deputy Commissioner of the district, and Mr. Cannell, Superintending Engineer of the Lower Bari Doab Canal, and Messrs. Chambers, Jesson, Dhody, Varma, Purves and Gibb, Executive Engineers of the Lower and Upper Bari Doab Canals and the Upper Sutlej Inundation Canals. To all these gentlemen and to many more helpers throughout the province thanks on behalf of the department are due.

E. JOSEPH,

Director of Agriculture, Punjab.

The 10th September 1918.

APPENDICES.

APPENDIX I.

Report of the Principal, Punjab Agricultural College, Lyallpur.

I held the charge of the Office of Principal during the session 1917-18, except from October 10th to December 18th and from January 16th to 13th May, when owing to my duties on the Indian Cotton Committee, Mr. Wilsdon, the Agricultural Chemist, acted for me. The session was noteworthy in several respects, viz.—

- (a) It was the first year in which we worked as an affiliated College and the teaching given to the first year was for the University course. This will involve a certain amount of extra work for the next three years, or until the old course is finished.
- (b) In order to fulfil its function in influencing the education of the Province it was decided to start a class for Vernacular School Teachers in the session 1918-19. This is now in progress.
- (c) Arrangements were made for admission of large land-holders and men from the Chiefs' College, Lahore. This had been under consideration for about three years and 8 students of that class have been admitted for the session 1918-19. It was also decided to admit students from Sindh at the request of the Commissioner in Sindh, as it is realized the practical value of the training at Lyallpur will be very much greater for such students than the training given at Poona, where conditions are so radically different. Two out of 4 students proposed to be sent have been admitted to the College, session 1918-19.

War Service.—In addition to supplying 2 men to the Signal Company the College has been asked to supply 15 agricultural assistants for Mesopotamia. A number of names are being sent up for the latter. The College is fortunate in being asked to contribute directly to the carrying on of the war by helping in the growing of foodstuffs in Mesopotamia.

The session ending June 1918 is a record of satisfactory progress. Keen interest has been shown by the public in the institution. The demand for admission was 150 in 1917 and 223 in the present session. In the session under report we were able to select a large number of Matri culates, who had passed in the first division, and this was still more the case in the present year.

The number of students admitted was 88 and 37 in vernacular class. Out of the first year students, 8 resigned or left the College. To guard against this in future we have admitted 53 students this year and so far only 2 have left.

No class for Revenue Officers in Indian Rural Economy was held this year.

Vernacular Class.—There were 101 applications for admission into this class. The number of vacancies was limited as room had to be made for 10 men sent by the Registrar, Co-operative Credit Societies. Three Court of Wards students were also admitted. This left fewer vacancies than usual for ordinary students. The total number admitted to the class was 37, of whom 24 were ordinary students.

The question of starting a second vernacular course has been considered. As facilities at Lyallpur are exceptional the idea was to start a second class at Lyallpur, but during the session under report it was decided to institute a class for vernacular school teachers and this is now in operation. Future expansion along the lines of the old vernacular course will, therefore, take place at Gurdaspur and Hansi, the two other circle headquarters of the Department in the Province. Lack of staff and other developments will probably cause another 2 years' delay before a class can be successfully started at Gurdaspur. It must be emphasized that the training given in the vernacular course is capable of immediate practical application as the boys return to their land except the few who are taken on as mukaddams in the Department. The value of the teaching is, therefore, very great in connection with the District work of a circle and should be regarded as important in any considered scheme of agricultural development and progress. The class at Lyallpur spends $\frac{4}{5}$ th of its time in the Agricultural section and $\frac{1}{5}$ th in other sections, viz., Botany, Entomology, Veterinary Science and Agricultural Engineering. As all this has to be carried out by one man at Gurdaspur or Hansi, the teachers appointed there must undergo one year's experience in the full course given at Lyallpur so as to know exactly the scope and range of the teaching.

Examinations.—The following table gives details of examinations held and the number of students at each examination:—

Class.	Number of students examined.	Number of students passed.	Number of students who obtained 1st Class.
Diploma	6	6	1
3rd year	4	4	...
Leaving Certificate	34	34	12
1st year	30	30	3
Vernacular Class	31	31	9

Scholarships.—The Entrance Examination for the year 1918-19 was held on the 6th May 1918; 150 candidates appeared in the examination of whom 10 have been awarded Government Scholarships.

Application for admission.—The following table shows the number of applications for admission from each division as well as from Native States, Sindh and other Provinces :—

Division.	NOMINATION BY DEPUTY COMMISSIONERS.		OTHERS.		Total.
	Degree Course.	Certificate Course.	Degree Course.	Certificate Course.	
Ambala	6	1	2	2	11
Jullundur	12	4	13	6	35
Lahore	12	9	23	14	58
Multan	16	4	27	13	60
Rawalpindi	7	...	12	7	26
North-West Frontier Province ...	...	...	...	1	1
Native States and other Provinces	...	...	8	16	24
Chiefs' College	...	...	6	2	8
Total	53	18	91	61	222

Of the above I have in all selected 53 candidates for admission.

Following scholarships were awarded by District Boards and other institutions for the English Course :—

One each by Jhang, Jullundur, Dera Ghazi Khan, Ferozepore and Hoshiarpur and 2 by Rohtak,

Following scholarships by District Boards were also awarded for Vernacular Class as per detail below :—

One each by Gujrat, Montgomery, Jhang, Muzaffargarh, Hoshiarpur and Gujranwala, and 2 by Rohtak and Mianwali and 3 by Lyallpur and 8 by Registrar, Co-operative Credit Societies.

Endowments—

	Rs.
Rai Bahadur Mohan Lal	144
Jind State	420
Patiala	240
Chamba	180
Kashmir	327
North-West Frontier Province	600

I wish to express my hearty thanks to all these donors for their generous support to the cause of the agricultural education in the Province.

Government Research Scholarship.—This was awarded to Chanda Singh who stood first in the Diploma Examination. The subject selected for study is "Co-operative Credit in its relation to agricultural development."

Buildings.—Further estimates are being called for for extensions to the College and residential buildings.

Provision will be necessary for a Boarding House and buildings for the New Teachers' Class which has just commenced. The cost of the latter will be borne by the Education Department.

Eight quarters built for the Court of Wards and Chiefs College students which are in use now, will require some additions and alterations in view of experience gained this year.

Hostel, Clubs, etc.—The general health of the students has been quite satisfactory throughout the year.

Social intercourse between staff and students has been satisfactory and some of the new-assistant professors have given much satisfaction in this respect especially in games. Lala Jai Chand, Superintendent of the Boarding House, has continued to work well and given me invaluable assistance.

As noted already the duties of Principal were carried out by Mr. Wilsdon from 18th October 1917 to 18th December 1917 and from 6th January 1918 to 12th May 1918 during my absence on Indian Cotton Committee. Mr. Faulkner, 3rd Deputy Director of Agriculture, conducted the teaching work. Three assistant professors, *viz.*, Chemistry, Botany and English, have been added to the staff. Three demonstrators have also been sanctioned of whom one has been recruited so far. The other posts will be filled as soon as suitable men are forthcoming. These additions to staff were necessitated under the regulations of the Punjab University to which the College is now affiliated.

College Prospectus and Syllabus.—An amended prospectus is being submitted for sanction of Government. The syllabus for the 2nd part of the 4 years' course will be put up shortly.

W. ROBERTS,

Principal, Punjab Agricultural College, Lyallpur.



APPENDIX II.

Report of the Agricultural Chemist.

1. *Staff*.—Mr. B. S. Mehta, Research Assistant, went on one year's leave without pay on 8th August 1917 to work as Chemist to the Indian Dairy Company, Anand. Bhai Balwant Singh was appointed in his place on 1st December 1917.

2. *Provincial Work*.—65 samples of soils, manures, feeding stuffs, fodder, cotton and other materials were analysed for the Department and for private persons.

3. *Reclamation of barren land in Montgomery*.—(a) *The Ganji Bar Experimental Station*.—The proposal made last year for the institution of an Experimental Farm for the purpose of research work on the various types of sterile soil met with on the Lower Bari Doab Canal has been sanctioned by Government and an area of a block of 625 acres in 138 of 9-L has been allotted, in which the required diversity of soils is found. Besides this an area of 1,000 acres has been selected for the trial of the methods proposed by the late Mr. Barnes and yet more land has been allotted for the trial of reclamation by bullock power and for leases to selected cultivators who will work under the direction and control of the Department. The work has been put under the control of the Agricultural Chemist, but will, through lack of staff, be necessarily and mainly limited to experimental work for the present. It is intended however to develop this large block of land allotted for the various schemes in such a way that it may conveniently become the headquarters of a Reclamation Circle under the control of a Deputy Director.

(b) *Laboratory investigation*.—180 samples of the soils included in the experimental block have been taken and are under investigation. Conventional methods of soil analysis show that there is no constitutional peculiarity which distinguishes the barren soils from adjoining normal and culturable land. Special methods have consequently been needed to determine the deleterious factors influencing the soil fertility. It has been found that the salinity of the soils is not really so excessive as in the case of the Rehy soils of Narwala, but pot culture experiments kindly conducted according to my instruction under the direction of the Imperial Agricultural Chemist at Pusa have shown that under certain conditions there is a possibility of forming "Black Alkali" in the soils on irrigation with a hard water. Black Alkali is several times more toxic than the Sodium Sulphate or White Alkali generally met with in the Punjab. Whether these factors will prove responsible for the infertility of the soils under cultural conditions will be proved when field experiments are put in hand.

Another factor which has a profound influence in modifying the texture and consequently the culturability of the soil is to be referred to the deflocculated nature of the clay. Two methods for the investigation of the factor are being tried—the first an electrical method, and the second a dye absorption method. The results seem likely to prove of importance and to conform to observation recently made by American investigation.

4. *Work in connection with Canal Seepage*.—(a) The study of the fundamental question of the flow of viscous liquids in porous media is being continued. An apparatus for this purpose has been constructed and results, it is hoped, will be forthcoming shortly.

(b) The study of moisture conditions by actual field experiments is being continued.

5. *Sugarcane survey of the Rohtak District*.—The agricultural survey of sugarcane was conducted this year in the Rohtak District on the lines followed in Karnal District during the previous two years.

The object of this survey is to find out some suitable place for the opening of a Government Sugarcane Farm and to investigate the possibilities for the installation of a sugarcane factory in the Southern Punjab.

Lalri and Suretha (Sorthi) are the two varieties generally grown in this district, of which lalri is more common in Rohtak. The yield and quality of the canes grown here is much better than that of the Northern Punjab. Moreover, the canes here are not subjected to the effect of frost as in the Gurdaspur District and other sub-montane tracts. Some 30,000 acres (*i.e.*, more than $\frac{2}{5}$ of the total area under cane in both districts, Karnal and Rohtak) is grown in the two tahsils of Sonapat and Panipat. The land is good and canal water is available almost in every village of the tahsils lying on the south-west of the East Indian Railway line. In addition to the above advantages there are easy means of transportation. Besides, the East Indian Railway, the Grand Trunk Road and the Western Jumna Canal (which is navigable) are easily accessible.

The purposes for which the survey was commenced have now been attained, and farther work in other districts will not be continued. The results indicate that some place such as Samalkha or Sonapat will be best situated for the Government Cane Factory when conditions allow of its being started.

A departmental report on the subject is being prepared for the press.

6. *Survey of Punjab Oil Seeds*.—So far work has been limited to Toria, Sarson and Rape. Other crops will be investigated in time. The work is being conducted in collaboration with Mr. Faulkner who aims at selecting more profitable varieties.

7. *Bacteriological Work.*—(a) Experiments on Nitrogen Fixation have been continued and extended.

(b) Preliminary experiments on the effect of varying concentration of nitrogenous foods on the rate of nitrification have been completed and will be extended.

8. *Experimental Sullage Farm.*—Experiments directed towards determining the most economical methods of applying sullage to agricultural land have been designed and tanks have been constructed out of the proceeds of a grant of the Sanitary Board. Actual experiments with sullage have not yet been started as the land which has been put at my disposal by the Lyallpur Municipality has not yet been sufficiently evened up by cropping.

9. *Special investigation not directly connected with Agriculture.*—(a) A report on the question of saline efflorescence in brickwork and the colour of brick was submitted to the Public Works Department. Analyses show that the main source of trouble is the use of extremely poor quality, or adulterated lime.

(b) Experiments regarding sedimentation with Aluminium Ferric with bacteriological control at the Lyallpur Water-Works have been continued.

B. H. WILSDON,

Agricultural Chemist, Punjab, Lyallpur.

APPENDIX III.

Report of the Economic Botanist.

Cottons.—Evidence regarding cotton growing and cotton improvement in the Punjab was given to the Indian Cotton Committee. That may be consulted.

Here for the future progress of that work I may emphasize that it is essential to know the real cause of the phenomenal spread of American cottons in the Punjab in the past half dozen years approximately. In my opinion the important factor is that there have been varieties available to farmers since then, so improved as to consistently yield more maunds per acre, and more money per maund, than any other cottons. Briefly my reasons for this belief are—

- (a) American cottons, although repeatedly tried in the Punjab since 1850, consistently failed to establish themselves even with the help of special sales extra water supply gratis, etc., from Government and as late as 1908 they were a loss to the growers (*vide* report of operations of the Department June 1908, Appendix II, paragraphs 1-4).
- (b) Before the improved cottons evolved in the Botanical Section had been sent out to zamindars by the Professor of Agriculture—the route prescribed by rules of the Department—many farmers had recognized their value, and similarly improved cottons which keen growers had got hold of with private help from members of the Botanical Section had firmly established themselves on many thousand acres of zamindari lands, without any other help from Government. These cottons spread as fast as seeds were available—the seed being sold at premium rates.

When 4-F got out it was sought after even more eagerly.

Care must be taken, therefore, to keep the same points in view in evolving further varieties and to keep them pure when evolved. Unfortunately, it has not yet been realized that the evolution and keeping pure of these improved types is a specialist's work.

In my evidence I outlined a scheme for keeping cultivators supplied with pure seeds at minimum cost and trouble. I also showed that irregular lint can be got from pure-bred seeds by certain influences of soil, irrigation and cultivation. With the present Punjab standard of cultivation and conditions I think we ought to avoid excessively long-linted cottons. Lengths from 1 to 1.1 inches are suitable for Lancashire and should be our present standard.

The Punjab climate is not unsuitable for growing cottons fit for Lancashire.

I briefly outlined a scheme for preventing mixing and adulteration of cottons. It leaves movements of cotton consignments free; does away with the Army of Inspectors often proposed; does not require combination among buyers; enables buyers to give a zamindar maximum value for his cotton with perfect safety, etc.; but as it would almost certainly prevent buyers purchasing cottons from growers below their real value, opposition to the proposal is not unexpected.

Wheats.—In the mass of wheat work being carried on an important point is the fact that as regards outturn of grains, type 8-A., a bearded wheat with good hard amber grain rich in nitrogen, has again beaten the best wheats grown in the Punjab, including Punjab-11 and Pusa-12. In the Botanical Section it has consistently beaten the favourite wheats for five years—its average outturns ranging from well over 20 to well over 30 maunds per acre.

8-A., with some other promising types, was handed over to the Professor of Agriculture in 1914. On his farm it has yielded better than Punjab-11 which in turn was proved better than Pusa-12.

It has been grown three years at Hansi. The lands are rather uneven, but after looking into the trials as far as possible all data seem to indicate that it is the best wheat there. Last year in duplicate sets with Pusa-4, Pusa-12 and other new wheats it gave 29½ maunds grain per acre and headed the list by a substantial difference. This year it has headed the list with 31½ maunds per acre in tests with Punjab 11, 14 and 17, Pusa-12, etc. In this test it gave 3 maunds 14 seers per acre more than Punjab-14 which being the main type in the local mixture was used as standard.

At Sialkot this year under zamindari conditions in full acre trials it gave 21½ maunds while the local wheat gave 12½ maunds.

In Sargodha Seed Farm in triplicate sets with Pusa-12, Punjab-11, etc., it headed the list with about 2½ maunds per acre over Punjab-11, and 6½ maunds over Pusa-12.

Zamindars in Sargodha Colony, who have grown it for two years—last year on 8 acres—want all the seeds they can get of it.

In small areas grown in Muzaffargarh in connection with eradication of ear-cockle it did so well that the zamindars want more.

In Peshawar Agricultural Farm tests in the past year it headed the list of outturns.

At Gurdaspur it has been grown three years. In 1915-16 grown on chahi land alongside three others, it gave 26½ maunds per acre—the highest outturn. In 1916-17 on chahi land it gave 6 to 8 maunds per acre more than Pusa-12 interstripped with it and others. This year Pusa-12 apparently beats it at Gurdaspur, but the Deputy Director informs me that owing to excessive rains at harvesting time in 1917 some of the grains in the wheat bundles were germinating even before threshing, and that the seeds of S-A and several others were taken from what appeared the least damaged bundles, while the seeds of the Pusa wheats were stored before rain had harmed them. In the Gurdaspur experiments, yields of wheats which usually flower at normal flowering time were also obviously considerably affected by rains which chanced to fall during the 2nd and 3rd week of March at the time when they must have been ready for fertilization, and the Pusa wheats being earlier would have escaped. The ideal wheat, however, is one which entirely occupies the wheat growing and developing period and ripens just before the weather gets hot enough to interfere with maturity. Low temperatures in part of February, in March and early April would account for flowering being a few days later than usual and for ripening being a week or ten days late.

Ear-cockle (Tylenchus Scandens) Disease in wheat.—This disease has been found doing ruinous damage to wheat crops on certain farms, and all evidence to hand indicates that it is the most important wheat disease on the western side of the Punjab. Briefly, our experiments have shown that we can clean any farm of disease in a single year at practically no expense to the farmer, and without upsetting his rotations.

Potatoes.—Scotch potatoes introduced into the Simla hills in 1909 continued to yield up to cent. per cent. more than the local potatoes interstripped in fields with them. Breeding potatoes from true seeds, entirely neglected in India previously, is proceeding and is a most promising line of work.

Miscellaneous.—Unfortunately, there is no space to mention work on barleys, grams, maize, oats, date palm, figs, etc. I regret that a number of valuable experiments in the Botanical area were again destroyed by thefts last year. In past years, cotton work has been set back years through similar damage, and many experiments on other crops have suffered severely. I am, therefore, very glad to state that the new Director has restored to me the right to close the private paths in my experimental area to all except those I approve of being there. I hope the fence for this area will be completed soon.

This is not quite an accurate statement of the conditions on which I agreed to the closure, but I am glad to find the Economic Botanist approves of the exceptions I made.

E. J.

In my last year's annual report I tried to show that the provision of really improved types of cotton was the main factor in the spread of Americans in the Punjab, but I find that that and other parts of my report have been deleted from the printed report over my name. In the light of my ten years' experience here I am compelled to state that I cannot be responsible for these reports or even for the work of the section if such things happen. The annual reports of the Department in past years also contain many statements by various people which must have misled higher officials as to the value of the work done in the Botanical Section and caused an atmosphere which made progress more difficult.

As I have already so often pointed out, the real source of our misunderstandings and difficulties is defective organization, and I am quite sure that there will be much more of the same thing whoever the parties concerned may be, if the organization is not radically altered.

Staff.—Lala Chuni Lal, M.Sc., has been appointed Assistant Professor of Botany to the Agricultural College. He has had the disadvantage of having to start teaching applied Botany without having had a training in that special line himself, but he is working hard to make up this serious handicap.

Staff are urgently wanted for work on cotton, wheats and other crops which we are unable to deal with.

D. MILNE,

Economic Botanist, Lyallpur Punjab

APPENDIX IV.

Report of the Assistant Professor of Entomology.

I held charge of the section throughout and in addition to teaching in College, which has increased considerably, the following entomological and sericultural work has been carried out :—

I. *Entomological work*.—1. *Insect pests of cotton*.—Cotton bollworm (*Earias insulana*, Boisd and E. Fabia, Stoll) and its parasites.

The parasite *Rhogas* was successfully bred and distributed in cotton tracts. There were no bollworm complaints. This season also bollworm attack is below normal and parasites are present.

Three new parasites have been discovered on *Earias* : a Tachnid fly on larvae and a brown Braconid and a black Chalcid on pupas.

Phycita infusella, Meyr ; and *Tarache notabilis* occurred on young cottons but were destroyed by regular hand picking.

2. *Monophlebus on mangoes*.—*Monophlebus* is a serious pest on mango blossoms in certain tracts. Last season the following measures were tried at the Shalamar Gardens, Lahore, to prevent the bugs from ascending the trees and reaching the flowering shoots :—

(a) Bands of well carded cotton wool with fluffy side outwards were tried on the trunks.

(b) Grease bands were applied on trunks.

Both proved effective and insects could not cross them. Of the grease bands tried the crude vaseline and rape oil band was best. Further trials will be made next season.

3. *Euphalerus citri*.—The utility of regular spraying against this was demonstrated at Sargodha. Three gardens have been sprayed from March to June with crude oil emulsion and tobacco decoction. They are all bearing good fruit this year. The pest has got a thorough hold of all the gardens in the whole tract ; it is, therefore, essential that people should unite to fight it out by regular spraying.

The life history and habits of this psylla have been worked out.

II. *Sericulture work*.—921 ounces of silkworm seed were reared in various districts from February to April. The results are tabulated as follows :—

District.	Amount of seed reared.	Total crop.	Money realized.	REMARKS.
		M. S. C.	Rs. A. P.	
Gurdaspur ...	739 ozs.	119 26 4	14,938 15 9	415 ozs. were reared by Shaikh Ghulam Sadik, 150 ozs. by Kotu Mal and Ram Lal and 174 ozs. by us.
Sialkot ...	40½ "	4 25 10½	851 14 9	All the rearings were organized and supervised by us.
Hoshiarpur ...	72 "	10 22 8	1,510 7 0	
Ambala ...	29 "	7 7 4	1,005 6 0	
Amritsar ...	25 "	1 16 7	170 18 6	
Kangra ...	9 "	0 31 0	102 1 6	
Jullundur ...	1 "	0 4 8	15 12 0	The State made its own arrangements for rearing.
Lyallpur College ...	½ "	0 6 8	Not sold.	
Kalsia State ...	5 "	Results not available.	...	
Total ...	921 "	144 4 14	18,625 6 6	

Silkworm rearers earned Rs. 18,625-6 6 from the sale of cocoons and an additional Rs. 1,000 has been made by a few rearers who sold reeled silk instead of cocoons.

The silk cocoon exhibition was held at Gurdaspur on 7th and 8th June and at Zaffarwal on 23rd June. They were both a great success and Rs. 364 were distributed in small prizes to successful rearers.

A considerable demand for the sericulture industry has arisen of late years in the Province and to provide for it and organize it on economic basis, two things are immediately needed :—

- (i) The abolition of the middle man agency which does not allow the rearers to realize the full value of their crop, and
- (ii) The creation of a small whole-time sericultural staff.

MADAN MOHAN LAL,

Assistant Professor of Entomology, Punjab, Lyallpur.

Appendix V.

Report of the Agricultural Engineer.

Introductory.—A further increase in the price of materials and plant having taken place during the past year has resulted in considerably fewer enquiries for lift irrigation and consequently less progress has been made than in previous years.

Well boring.—The work of augmenting the supply of water in ordinary wells, for which a staff of three supervisors, twenty borers and twenty mates is maintained has fallen off considerably in the past year for the following reasons :—

The exceptional monsoon of 1917 rendered this class of work unnecessary for the time being and cultivators proved unwilling to insure against a future water shortage. Materials for the work were difficult to obtain and the stoppage of goods traffic on the railways delayed very considerably the carrying out of such work as there was to do.

These circumstances resulted in only 337 bores being sunk in the year, the number sunk in the previous year being 538 or a decrease of 201. The number of successful borings was 251 giving a percentage of 74·4 as compared to 69·3 per cent. in the previous year.

It is now an established fact that this type of well augmentation can be made successful in every case and failures are due entirely to the unwillingness of the cultivator to pay the cost necessary to obtain success.

The present very high price of materials has necessitated a slight enhancement of the rate charged for these to the cultivator, although the work is still carried out at considerable loss to Government ; but this enhancement has not been sufficient to deter the public from availing themselves of the advantages of well augmentation.

Soils which two years ago could not be exploited by the ordinary methods of boring are now yielding a considerable water increase by the use of strainers at very low cost as shown in appendix B.

Tube wells—The work of sinking large diameter bores for the extraction of water by mechanical means has also fallen off in the past year, chiefly owing to the high prices of materials, and partly on account of less necessity for lift irrigation due to the abnormal monsoon of 1917.

Three such installations have been completed during the year, the average yield being approximately 30,000 gallons per hour at a cost of Rs. 27,000 for the three. A fourth installation of this nature has been in progress for several months and, owing to the exceptionally low porosity of subsoil met with, has not yet been completed. This installation, situated in the Mamdot Estate at Jallalabad, is at present undergoing special treatment to secure success. Another installation at Chak Hiraj in the same estate is also in progress.

Boring plant.—Financial stringency still prevents the purchase of heavy boring plant and hence artesian supplies have not been exploited.

A light boring plant arrived in April and was put on trial work for a few weeks, many special tools having to be designed and made up to suit Punjab conditions. This plant gave promise of good work and has been handed over to the Military authorities for rapid boring.

Difficulties and delay in obtaining plant combined with financial stringency has again postponed investigation work in deep lift irrigation on a large scale.

Farm implements.—A cheap form of seed distributor has been designed and experimented with for several months. This drill is successful with certain types of grain and experiments are still in progress with the object of obtaining one drill suitable for most seed types in general use.

A cultivator with parallel motion of tynes and novel lock arrangement has been designed and appears to meet a long felt want of the agriculturist. Arrangements are being made to place this implement on the market as early as possible.

I am greatly indebted to Mr. Faulkner for the time and labour he has spent in testing these implements and for his suggestions of types to meet the requirements of the agriculturist. Without such co-operation it would be impossible to attempt the production or improvement of implements suitable for Indian conditions.

Other works.—A well head which obviates the necessity of a second man for the emptying of the charsa (or leathern bucket) and returning the same to the well has been designed and a working model made up. The full sized machine awaits the provision of land for testing this and similar machines.

A small size motor driven pump for irrigation purposes was installed at Lahore.

The difficulty in obtaining corrugated iron has resulted in the design and production of a substitute which proves satisfactory.

Over fifty detailed plans have been made for various installations and proposed implements, etc., apart from a large number for other sections of the department.

The construction of implements, fittings, parts of plants, etc., is greatly handicapped owing to the lack of a properly equipped workshop.

T. A. MILLER BROWNLIE,

Agricultural Engineer to Government, Punjab.

Appendix A.

WELL BORING.

Serial No.	Name of district.	WELLS.		REMARKS.
		Number of bores.	Successful.	
1	Gurgaon ...	44	41	Rewari Circle— Percentage of success 85.0.
2	Karnal ...	23	17	
3	Ambala ...	13	10	
	Total ...	80	68	
4	Jullundur ...	10	5	Jullundur Circle— Percentage of success 71.1.
5	Hoshiarpur ...	48	32	
6	Amritsar ...	19	18	
7	Gurdaspur ...	12	9	
8	Gujranwala ...	3	3	
9	Sialkot ...	12	7	
	Total ...	104	74	
10	Multan ...	25	21	Ludhiana Circle— Percentage of success 71.2.
11	Lahore ...	54	45	
12	Ferozepore ...	36	18	
13	Ludhiana ...	38	25	
	TOTAL ...	153	109	
	GRAND TOTAL ...	337	251	Percentage of success 74.4.

Appendix B.

DETAIL OF STRAINERS USED IN WELLS IN THE PUNJAB.

District.	Strainer number.	Average yield of well before strainer was used, in gallons.	Yield after strainer was used, in gallons.	Average cost per well.	REMARKS.
		<i>Prior to</i>	<i>July 1917.</i>	<i>Rs. A. P.</i>	
Hoshiarpur ...	44	619	2,163	76 9 9	Jullundur Circle.
Jullundur ...	1	931	3,106	83 10 0	
Amritsar ...	22	768	2,638	85 9 9	
Sialkot ...	6	469	1,938	71 3 6	
Montgomery ...	12	637	2,619	51 0 0	Ludhiana Circle.
Lahore ...	47	672	2,269	74 3 0	
Multan ...	6	412	1,919	107 0 0	
Ludhiana ...	5	500	2,000	68 0 0	
Gurgaon ...	2	500	3,500	150 0 0	Rewari Circle.
Karnal ...	2	1,000	3,900	120 0 0	
<i>Since July 1917 to June 1918.</i>					
Hoshiarpur ...	27	675	2,200	145 0 0	Jullundur Circle.
Amritsar ...	19	800	2,675	172 0 0	
Gurdaspur ...	8	575	2,445	128 4 0	
Gujranwala ...	2	615	2,273	136 0 0	
Sialkot ...	7	500	2,150	132 0 0	Ludhiana Circle.
Multan ...	19	425	2,300	140 0 0	
Lahore ...	33	700	2,175	135 0 0	
Ferozepore ...	7	575	2,900	120 0 0	
Ludhiana ...	6	625	2,600	133 0 0	Rewari Circle.
Gurgaon ...	1	795	2,385	140 0 0	
Karnal ...	2	593	2,385	158 0 0	
		385	3,507	145 0 0	
Total ...		931	5,892	303 0 0	
		353	2,487	120 0 0	Rewari Circle.
Ambala ...	3	415	2,700	266 0 0	
		326	2,886	150 0 0	
Total ...		1,094	8,073	536 0 0	

APPENDIX C.

TUBE WELLS.

Completed during 1917-18.

For general irrigation purposes, each tube yielding over one cusec discharge—

- (1) Dera Ismail Khan (put in by Municipal Committee).
- (2) Dairy Farm tube well (owner Dairy Farm Syndicate, Lahore).
- (3) Guru Harsahai tube well (put in by the Court of Wards).

Tube wells in progress.

- (1) Chak Hiraj in Mamdot Estate.
- (2) Jallalabad tube well.

APPENDIX VI.

**Report of the Professor of Agriculture, Punjab, on the Lyallpur
Farm and on District Work in the Chenab and Lower
Bari Doab Colonies.**

1. *Introductory.*—I was in charge of the Agricultural Station except from October 8th 1917 to December 18th, 1917, and January 16th, 1918 to May 13th, 1918, when Mr. Faulkner carried on the work alone during my absence on the Cotton Committee.

The rainfall for the season totalled 23·93" as compared with 9·39" for the previous year and an average of 14·85" for 5 years—15·78 for 10 years (see statement I). The heavy rains in August and right up to the end of September caused a great deal of damage to cotton but less so to American than Desi. Exporters estimated the yield of American to be two maunds per acre of kappas higher than Desi. The length of the flowering season in American as compared to Desi renders the former much less susceptible to rain than the latter.

Canal supplies were exceptionally good and followed a copious monsoon. The result was very heavy gram sowing in all the colonies. The season was favourable for wheat except that rust was bad in late February and March. Rust appeared in January but was very slight up to end of February. Yield of grain turned out to be less than was expected generally.

Grain was slightly shrivelled probably owing to rust and rapid ripening in April. The season was very favourable for gram which yielded particularly well everywhere. The season was very unfavourable for maize owing to heavy rain. Sugarcane and toria also suffered.

EXPERIMENTS ON THE FARM: ALL ON IRRIGATED LAND.

(NOTE.—Average yields are calculated per acre.)

Cultural and other experiments in area C, square 27, with wheat, maize and sugarcane.

The rotation is maize, senji (as a catch crop), sugarcane wheat. The maize is manured.

Sugarcane.—A varietal experiment was conducted here. The late rains prevented the cane maturin properly and caused 'smut' in Suretha variety. Yields are good. (Statement II.) Average yields are —

			Mds.	Srs.
Katha (local variety)	...	...	32	32 Gur.
Kansar (thicker local variety)	...	...	37	28
Katha (local variety)	...	...	43	12
Suretha (imported variety)	...	...	40	17

Harrowing versus no harrowing in wheat.—The wheat rusted badly and lodged. Average yield was—

				Mds.	Srs.
Harrowed	...	...	...	22	34
Not harrowed	...	...	...	22	20

(Vide statement No. III.)

Maize in 'lines' and by 'kera.'—The maize crop was a failure throughout the colony. The results of the experiment confirm that of previous years in that very little benefit if any results from flat lines and interculturing in this area as the land is uneven. Results show 20 seers per acre in favour of kera. See also statement No. V where with tenants in 6 tests, lines plot yielded better in five cases. Average of lines = 12 maunds 29 seers and of kera = 11 maunds 17 seers. Ridging as in United States of America is under trial this year.

Senji.—Yields follow order of maize yields.

Manurial Block, Area D, standard K in square 27—see statement VI.

Maize, cotton and sugarcane.—The unmanured plots are mere strips—only the manured plots can be compared. See statements VII, VIII, IX and last year's report.

Wheat variety trials.—The main trials were concerned with the comparison of No. 11 and 8—A and 8—B Results in square 26 and with tenants are given in statements X, XI, XIII and XIV. Summarising the results in square 26 we have after wheat —

Area.	Plot.	Variety.	Outturn per acre.		Increase or decrease	
					s compared to	
		No.	Mds.	Srs.	No. 11.	
26-A-3	1a	8 A	12	0	+2	29
	2a	11	9	11	...	...
	3a	8 B	10	35	+1	24
	1b	8 A	20	26	+0	24
	2b	11	20	2	...	...
	3b	8 B	19	14	—0	28

Average for the whole acre is—

No.	Mds.	Srs.	Mds.	Srs.
11	14	26½	...	...
8-A	16	13	+1	26½
8-B	15	4½	+0	18

After cotton—

Area.	Plot.	Variety.	Yield.	Increase or decrease as compared with No. 11.	
				Mds.	Srs.
26-A-4	1a	8-A	19	4	-2
	2a	11	21	4	...
	3a	8-B	18	32	-2
	1b	8-A	28	12	+2
	2b	11	26	8	...
	3b	8-B	22	20	-3

Average for whole acre—

No.	Mds.	Srs.	Mds.	Srs.
11	23	26	...	...
8-A	23	28	+0	2
8-B	20	26	-3	0

As was the case last year 8-A again tops the list especially in the plot where wheat followed wheat as a previous crop. Attention may be drawn to last year's report in which it was stated 8-A was later than No. 11 and 8-B earlier. The season was favourable for late wheats. No. 8-B has stronger straw than No. 11 and No. 8-A weaker straw. Preliminary reports of milling tests from England indicate 8-A to stand low in the list. As for export purposes however strong wheats fetch little or no premium: the main question is yield.

Trials on new area.—(See statement No. XII.) Land is irregular but it is interesting to note that 8-A maintains lead in yield.

Trials on tenants' area.—(See statement No. XIII.) In addition to the plots on new area seven different tests of 14 plots were made with tenants. These plots are much more uniform and reliable for varietal comparisons than the new area. It will be seen that they confirm tests in square 26. Out of 7 tests No. 11 does better in 2 only but on the average it yielded 3 seers per acre less. The difference would have been greater except for one plot where No. 11 gave 4 maunds per acre more. If we omit this plot the average yield of 8-A is better by 30 seers per acre.

These tests will be repeated as until we have experience of a short season it will be difficult to dogmatize. The tests have, however, proceeded far enough to enable us to safely put out some seed of 8-A in the coming rabi.

No. 11 and 8-B. Wheats with Tenants. (See statement No. XIV.)

No. 11 is better in 5 out of 8 plots but average works out at 13 seers per acre better. If we omit plot 3 where the difference is obviously due to the quality of the soil No. 11 yields better by about 1 maund per acre. In square 26 as will be seen above No. 11 is very distinctly superior. The milling report received from Mr. Humphries puts No. 8-B at the head of the list and hence it is proposed to continue the tests for another year.

No. 11 and 17-B.—(See statement No. XVI.) 17-B and 9-C were handed over at the same time as 8-A and 8-B but had not been extensively tested until this year. No. 11 leads in all five tests and on the average gave 3 maunds 16 seers per acre more. 17-B will be discarded this year.

No. 11 and 9-C.—(See statement XVII.) No. 11 gives better yield in 4 out of five tests and on the average gave 2 maunds 22 seers more per acre. 9-C will be discarded this year.

No. 17 and Pusa 12.—(See statement No. XV.) Pusa 12 yielded better in 6 out of 7 tests and on the average gave 1 maund and 26 seers more per acre. This is contrary to results of previous years. No. 17 suffered from poor germination. The tests will be repeated.

Punjab 11 and Pusa 12.—With different number of waterings (see statement No. XVIII).

The yield is practically the same with 2 waterings and much less in case of Pusa 12 with 3 waterings.

Averages are—

			Mds.	Srs.
(a) For two waterings	...	Punjab 11	...	6 34
		Pusa 12	...	6 38
(b) For three waterings	...	Punjab 11	...	9 19
		Pusa 12	...	6 33

It should be noted that in plot 6-B the land is uneven and the tests not reliable. The general sense of the experiment shows Punjab 11 better with 3 irrigations, but practically equal with two. This test will be repeated. The land was poor.

A note on the wheat trials especially as regards Punjab 11 and Pusa 12 was published in the *Agricultural Journal* for January 1918.

Cotton Experiments.

Ridging as compared to flat lines with American cotton.—The heavy monsoon interfered with this test but experience has been gained in irrigating with ridges. This requires further study and practice. Definite tests to compare ridged with flat sowing are in progress. Results of heavier irrigation show a slight increase in yield of just over $\frac{1}{4}$ maund per acre. (See statement No. XIX.)

Line versus flat sowing.—Square 10, statement No. XX.

Results strikingly confirm experience and tests in the past. These tests were with Desi cotton and the facility offered for interculture in line plots was of great value in a wet year like the one under report. The average of the line plots = 9 maunds 36 seers and of broadcast-7 maunds 11 seers. See also statement No. XXI. Average of plots in lines = 10 maunds 33 seers and of broadcast = 10 maunds 18 seers. In latter experiment factor of number of waterings varied and renders result less reliable.

Tests with tenants.—(See statement No. XXII.)

With 280-F. American the line plots though receiving one irrigation less yielded an average of 10 maunds 20 seers as compared to 7 maunds 13 seers for broadcast plots.

With 'Roseum' Desi cotton results are similarly striking—

Average of line plot-12 maunds 31 seers; and of broadcast-8 maunds 37 seers.

Experiments in watering of cotton.—The object of these experiments was to see how far irrigation is necessary for the cotton crop during the dry period before flowering starts. If it could be proved that little water is necessary the water saved could be used for fodder crops, so that water may be available in July, August and September when the demand of the crop for water is generally very high. Statement No. XXIII shows the crop gave normal yield without any watering in May and June. Average yields are—

			Mds.	Srs.
3 waterings, i.e., in May, June and July	...	...	6	21
2 waterings, i.e., in June and July	...	...	6	36
1 watering, i.e., in July	...	...	7	8

As there was rain in the period under report (see statement I) all that these figures show is that in a year like 1917-18 the cotton crop requires no water after sowing up to July.

Statement No. XXIV. Averages are—

			Mds.	Srs.
3 waterings, i.e., in May, June and July	...	...	10	12
2 waterings, i.e., in June and July...	...	...	11	35
1 watering, i.e., in July	...	...	10	2
See also statement No. XXI where averages are as follows :—				
3 waterings	...	...	12	15
2 waterings	...	...	11	1
1 watering	...	...	8	22

In the latter test the experiment was complicated by introduction of another factor, viz., line sowing. The land is also uneven being recently acquired by the Farm.

It is hoped to get more conclusive data in a dry year on this point. This year's results show a good crop can be grown without water from April to 20th July.

Cotton Varietal Tests.

American cottons.—As is well known the variety of American cotton successfully introduced in the Punjab is No. 4-F. and now forms between 70 and 80 per cent. of the total American crop. The claims made for this type since its issue from the Farm in 1913 are that it is hardy, rough leaved and has a medium staple of full 7/8 inch or what would be classed commercially as 1." The varieties being tested against it are all except 275 superior to it in staple. The 'Risala' cotton which is a selection from seed issued by the Agricultural Department is longer in lint and was valued in Liverpool in 1916 1½d per pound over 4-F. The results of this year's tests will be seen from statement No. XXVII.

4-F. and No. 280-F.—In 13 out of 16 tests 4-F. is superior in yield and on average gave 1 maund 5 seers more per acre (see statement No. XXV).

4-F. and 275-F.—In 10 tests 4-F. gives better yield in 4 only. The average yield is less in 4-F. by 10 seers per acre (*vide* statement No. XXVI).

4-F. and Risala Cotton.—Out of 4 tests 4-F. yields better in 3 cases and on the average gave 27 seers more per acre.

Further tests are in progress and the whole position will be reviewed next year.

4-F. versus 'Roseum.'—See statement No. XXVIII.

Roseum is the 'standard' used in comparison of yields of 'Desi cottons.' It is the highest yielding of them except 'Mollisoni' but is not as good a cotton in quality as the des mixture of the district which is mostly 'Indicum.' In 4 tests 4-F. yields more in one only and practically equal in a second test. On the average it yielded 21 seers per acre less.

Desi varieties.—See statements XXIX, XXX and XXXI and summary in statement XXXII. As last year Mollisoni heads the list. Some seed of Mollisoni has been given out for trial this year to zamindars. It will be seen that Roseum is much better than the other two types. It should be noted that Mollisoni and Indicum yielded poorly in 1915-16 which was a dry year.

Experiments with Toria.—Square 26, statement No. XXXIII.

Harrowing immediately after sowing *versus* no harrowing.

The idea which was put forward by Mr. Faulkner is to break the crust slightly with the Bar Harrow to give a better surface for the tiny plant to develop. Results show an average increased yield of 1 maund per acre. Rain fell soon after harrowing but in spite of that the harrowed surface preserved a better tilth than otherwise.

See also statement No. XXXIV. New area where plots are less even—only a difference of 8 seers on average of 6 tests in favour of harrowing.

Number of irrigations after sowing.—See statements No. XXXV and No. XXXVI.

It will be seen that yield is poor in late sown crop and effect of extra irrigation beneficial.

Average yields are—

<i>Early sown.</i>					<i>Mds.</i>	<i>Srs.</i>
2 irrigations	...	...	...	...	8	12
1 irrigation	...	...	...	...	9	13
<i>Late sown.</i>					<i>Mds.</i>	<i>Srs.</i>
2 irrigations	...	...	...	...	5	37
1 irrigation	...	...	...	...	4	24

Hydraulic Experiments with Wheat.—Statement No. XXXVII and XXXVIII.

<i>Early sown.</i>					<i>Mds.</i>	<i>Srs.</i>
Average of 3 waterings	...	...	...	...	12	36
Average of 2 waterings	...	...	...	...	14	15
<i>Late sown.</i>					<i>Mds.</i>	<i>Srs.</i>
Average of 3 waterings	...	...	...	...	7	5
Average of 2 waterings	...	...	...	...	8	7

Green Manure Experiments.—See statement XXXIX (a), (b) and (c).

The crop was a failure and results poor. Sowing was much too late as water was not available for earlier sowing. Guara gave best results as in previous years.

Statement XL.—In one plot the fallow area gives $6\frac{1}{2}$ maunds more. This shows there is yet a great deal to be learnt about green manuring and some experiments have been started recently in co-operation with the Agricultural Chemist to try and solve the enigma.

Comparison of San and Guara.—Tenants area Statement XLI. As in other cases Guara gives best results. Guara removed depresses yield. Yields are as follows :—

			Mds.	Srs.
Average of San ploughed in	...	...	13	18
Average of Guara ploughed in	...	...	17	30
Average of San ploughed in	...	...	12	2
Average of Guara removed	...	...	8	35

Manurial and variety experiments with Sugar.—See statements XLII and XLIII.

Calcium Nitrate on Wheat.—See statement XLIV.

Hot Weather versus Rain Cultivation.—See statement XLV.

Yield is less in Hot Weather plots for 1st time in 8 years. Yields are—

Hot Weather Cultivation—

Average of 4 plots ... 9 Mds. 36 Srs. 4 Chk.

Rain Cultivation—

Average of 4 plots ... 12 Mds. 31 Srs. 12 Chk.

The main results of the year are as follows :—

- (1) Confirmation of value of line sowing and interculture for cotton.
- (2) Confirmation of position of 4-F. as regards yield.
- (3) Confirmation of Mollisoni being best yielding desi cotton in ordinary years.
- (4) Position of 8-A wheat as a good yielder strengthened for 3rd year in succession.
- (5) Demonstration of possibility of growing a good cotton crop with no water after sowing up to 20th July.
- (6) Beneficial effect of harrowing toria after sowing.

District work.—The circle in my charge comprises the districts of Montgomery, Jhang, Lyallpur, parts of Lahore and Gujranwala and also Multan, Muzaffargarh and Dera Ghazi Khan. The staff engaged in district work consists of an assistant director and 2 agricultural assistants at Lyallpur and 2 agricultural assistants at Montgomery. No work has been possible in the 3 south-western districts owing to lack of staff and comparatively little has been possible in Jhang and parts of Gujranwala. Provision of the necessary staff would have enabled us to double our results in such lines of work as line sowing, introduction of better wheat, use of bar harrows, etc. The main lines of district work will be taken separately.

Reapers.—Scarcity of labour and the fact that the crop was standing well rendered the season very favourable for reapers. The price of reapers is now Rs. 400 as compared to Rs. 255 before the war, but in spite of this 8 were sold, of which 5 were worked in the Colonies. Six old machines changed hands—five being worked in the Colony and 1 in Sindh.

One hundred and three reapers were inspected by the staff and 62 overhauled and put right before harvest. The number of reapers known to have been worked was 69 and the area cut 2,450 acres. High price of spare parts militates against success of reapers.

Little progress was made during the year in evolving and testing a suitable 'scythe' largely owing to shortness of staff but the matter is being again taken up.

Wheat Seed Farms.—Punjab type 11 has been distributed as in past few years. Wheat distribution is carried out through the following agencies, viz :—

1. The department after inspection of the crop buy and store what we consider can be handled and sold by our present staff during the sowing season. In the Lower Chenab 5,000 maunds was thus bought and stored and in the Lower Bari Doab 13,600 maunds.
2. Seed is stored by zamindars and sold either by them or by help of the department. This line of work is very important at Lyallpur and accounts for a very large but somewhat indefinite area.
3. Zamindars exchange seed with one another either with or without the department's instigation. The wheat has now a reputation in the colonies and those not growing it will take a great deal of trouble to secure seed from a neighbour.

In the Lower Bari Doab Colony process No. 1 is the most important factor and is worked by assistance from the canal and civil authorities. Such assistance is greatly valued by the colonist and is indispensable to the agricultural department in a new undeveloped tract. Arrangements are being made for assistance on a large and practical scale by the co-operative credit department in the year just commencing.

The total area under pure No. 11 in the Lower Chenab Canal and Lower Bari Doab Canal Colonies is at least $1\frac{1}{2}$ lakhs now, i.e. one lakh at Lyallpur and $\frac{1}{2}$ lakh at Montgomery. There is besides $\frac{1}{4}$ million acres of purity up to 90 per cent. Our main activities in wheat will be with No. 11 for next couple of years but if No. 8-A continues to fulfil expectations its distribution on large scale will be in progress three years hence. No. 11 did very well on chahi area in Jhang this year and on barani areas in Gujranwala as in previous years.

Punjab No. 17.—A small amount of seed was distributed to get pure samples for 'milling' tests. This wheat is much appreciated for home consumption and fetches four or five annas a maund premium at present in the local market. It is grown on a small scale very widely and used to be in large tracts the predominant wheat. It is, however, being replaced by No. 11 which is hardier and a better yielder.

Cotton Auctions.—Altogether 12 cotton auctions were held departmentally and two private ones in the Lower Bari Doab at which we gave assistance in classification and arbitration. The total kappas sold in auctions amounted to 120,000 maunds valued at roughly £150,000 sterling. This figure, though high represents only 10 per cent. or less of the total crop. The Indian Cotton Committee is reporting fully on cotton sales so that it is only necessary to draw attention to two points, viz., (a) the great size of the sale operations for a small department though only affecting 10 per cent. of the crop directly, and (b) the start of private sales. The latter is significant as it illustrates the fact that the zamindars are beginning to realize the necessity of co-operation. The two private sales held were conducted by the Okara Zamindar Association run by Colonel Cole and Major Vanrenen and by S. Jogindra Singh for his own and surrounding zamindars at Iqbalnagar. The co-operative credit department are now taking up the question of cotton sales and will ultimately, it is hoped, give valuable assistance so as to free the agricultural department for its true functions. The most serious handicap with regard to American cotton during the year under report was the lack of railway facilities, a continuance of which will very materially affect our efforts in the coming season.

Cotton Seed Farms.—The department sold 24 000 maunds of seed of 4-F. this year—or sufficient for 220,000 acres. This was sold at Rs. 5 a maund, the seed having been bought at prices ranging from Rs. 3-12-0 to Rs. 4-2-0 per maund. This left a handsome profit but it is necessary to conduct such operations on a business footing with a view to eventual handing over of the work to an independent agency or to the co-operative credit societies. The total area sown under American this year is estimated at 400,000 of acres and at least 80 per cent. of this is practically pure 4-F., the rest being other Americans and 4-F. The area in the Lower Bari Doab Canal alone is estimated at 150,000 acres as compared to 80,000 acres last year. The system followed with regard to cotton seed is as follows :—

The Farm crop is gone through carefully and selected plants true to type are marked and seed used for Farm crop of following year. The rest of seed is issued to one or two special men and is called Special No. 1. Seed from latter is bought and sold following year to another small circle and becomes available in 3rd and 4th year for the general crop. In this way the quality will be kept up and tend to go on improving from year to year. 'Parchis' are issued with each lot of seed sold and these are much appreciated and help the zamindar in bargaining for a proper price for his cotton. We had 42 centres selling cotton seed on commission this year.

Cotton and maize in lines.—The sowing of cotton in lines and interculture has been one of our main lines of work for several years. A change of this fundamental nature is bound to be very slow and difficult and has entailed constant study of methods of sowing and implements for this and for interculture. As stated last year we are beginning to reap results now. The area in lines in the Lower Chenab Canal has doubled but is still behind the Lower Bari Doab where the area sown in lines this year is known to be at least 7,200 acres. The total area in lines in my circle is estimated at 12,000 acres this year. It must be remembered that holdings are smaller on the Lower Chenab Canal and there are fewer large landlords, hence progress is slower in area though very encouraging in number of new converts. We have reached the stage when our assistants are constantly coming across an acre or two sown in lines in the districts of which we had no official knowledge. Some cultivators have inter-cultured 6 times and the value of this operation is being more and more appreciated.

Country made implements.

Bar Harrows.—These harrows which were first evolved in 1914 are becoming very popular and there is a steady demand for them all the year round. They were meant in the first instance for harrowing young wheat and used to cost Rs. 7 each. Last August Government gave a grant of Rs. 5,000 to enable the department to sell these harrows at a price not much above pre-war rates. Three hundred were made on contract at Rs. 12 each and sold at Rs. 8.

More are being made now and the price will probably be raised to Rs. 10 each. Three hundred and six were sold in the year under report. We had assistance from the Deputy Commissioner (Mr. Kitchin) in popularizing these harrows but indents by Tahsildars and others were not complied with—only actual cultivators who intended to use the implements were supplied. Experience in the past has taught us this lesson as it is not by selling but getting a machine used and appreciated that real and solid progress is made. A curious experience with the bar harrow has been its great popularity for harrowing young cotton to save crust formation and to obviate re-sowing after rain. Sales were fairly heavy in April, May and June for this purpose alone. It is used for a variety of purposes, *e.g.*, harrowing young cane and lately as will be seen from the farm report it may prove of much use with toria. Complete record of the area of wheat harrowed is not available but 45 machines inspected had done 3,935 acres or an average of 85 acres each. Chak No. 267, R. B., mentioned in last year's report now possesses 34 of these harrows. Another village near Shahkote harrowed 2,400 killas of wheat this year.

Drills and Hoes.—Of the Lyallpur drills 64 Kharif and 68 Rabi types were sold during the year. It should be noted that many cultivators feel safer in sowing cotton and maize in lines with the plough and marker especially when land is rough and not properly cleared as in the new colony. Steady progress is, however, being made with drills. The Lyallpur hoe which is not quite satisfactory and is, therefore, only sold on demand was also in request and 59 were sold during the year. A type of hoe on the lines of the "American Planet Junior Hoe" in the evolving of which Mr. Faulkner, Mr. Brownlie and the Farm staff deserve credit is also showing great promise. The American implement which now costs Rs. 66-8-0 is in steady demand and 25 recently imported are nearly all booked. This shows the demand that exists for a satisfactory hoeing implement, and if we can produce something under Rs. 30 its influence on 'line sowing' and interculture will be very great. I wish to draw particular attention to our work on country made implements as I consider large scale progress is only possible in this way. Our Indian assistants have shown great patience and initiative in this work and what progress has been achieved would have been impossible without them. I would particularly mention Chaudhri Muhammad Abdullah, Bhai Indar Singh and Lala Anant Ram on the Farm staff and Bhai Charan Singh and Bhai Kharak Singh on the College staff.

Foreign Implements.—The Narbadda Reaper was worked throughout the season and a type of serrated knife requiring no sharpening during the season has also been promising. No final conclusions have been drawn as yet, and this matter will be further investigated this Rabi. No progress was made with 'scythes' during the year.

Ploughs were practically unobtainable and the new types mentioned in last year's report cannot be put on the market until after the war. Assistance in our work received from officers outside the department will be acknowledged in Director's report.

Mr. Faulkner co-operated with me in all Farm and College work and was for about 5 months in charge of the Section. Very good work has been done during the year by Chaudhri Muhammad Abdullah and by Bhai Indar Singh at Lyallpur and by Bhai Labh Singh, the Agricultural Assistant in charge at Montgomery, where enormous expansion of work has taken place.

W. ROBERTS,

Professor of Agriculture, Punjab, Lyallpur.

1	2	3	4
Name of month.	Rainfall during 1917-18.	Rainfall during 1916-17.	REMARKS.
June ...	2.51	.40	
July ...	2.79	1.12	
August ...	6.97	4.67	
September	10.43	.43	
October ...	...	.42	
November	...	...	
December	...	...	
January ...	.01	...	
February	.03	...	
March ...	.72	.43	
April ...	.47	1.48	
May ...	...	.44	
Total	23.93	9.39	

No. of plot.	No. of sub-plot.	Name of variety.	AREA.		WEIGHT OF GREEN TOPS.		WEIGHT OF CANE.		WEIGHT OF JUICE.		WEIGHT OF GUR.		YIELD OF GUR PER ACRE.		Percentage of green tops to cane.	Percentage of juice to cane.	Percentage of gur to juice.	Percentage of gur to cane.	REMARKS.	
			Kanals.	Marlas.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.						Chataks.
1	1	Kansar ...	2	0	58	10	92	36	56	33	10	12	41	8	0	62.7	61.1	18.1	11.08	
	2	Katha ...	2	0	71	19	81	19	42	25	8	0	32	0	0	87.7	52.3	18.7	9.8	
	3	Kansar ...	2	0	82	30	72	15	41	12	8	22	34	8	0	45.27	57.06	20.7	11.8	
	4	Katha ...	2	0	65	4	83	4	43	16	8	16	33	24	0	78.3	52.2	19.3	10.1	
	5	Suretha ...	2	0	55	37	117	26	62	0	11	5	44	20	0	47.5	52.6	17.9	9.4	Badly smutted.
	6	Katha ...	2	0	75	34	109	34	55	36	10	20	42	0	0	69.04	50.8	18.7	9.5	
	7	Suretha ...	1	13	34	13	73	8	37	2	7	20	36	14	0	46.8	50.6	20.2	10.2	Badly smutted.
	8	Katha ...	2	0	65	28	110	30	54	10	11	6	44	34	0	59.2	48.9	20.5	10.06	

						Mds.	S.
Ploughings	...	...	...	9			
Harrowings	...	...	...	6			
Sahagings	...	{ before sowing	...	7	Average yield	{ Katha	32 32
		{ after sowing	...	5		{ Kansar	37 26
Hoeings and harrowings	...	...	...	12		{ Katha	43 12
Waterings	...	...	...	11		{ Suretha	40 17
Date of sowing—9th April 1917.							
Crushing ... { began on 13th February 1918.							
{ finished on 1st April 1918.							

Statement No. 3.

RESULTS OF HARROWING *VERSUS* NO HARROWING ON WHEAT GROWN IN ROTATION SERIES, AREA C, SQUARE 27, RABI 1917-18.

No. of plot.	No. of sub-plot.	Variety.	Treatment.	Area.		ACTUAL OUTTURN.				OUTTURN PER ACRE.				REMARKS.
				Kanals.	Marlas.	Grain.		Bhusa.		Grain.		Bhusa.		
						Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
27	1	Punjab Type 11.	No harrowing ...	2	0	5	8½	12	19½	20	33½	49	38½	Ploughings ... 8
	2		Harrowing ...	2	0	5	9½	12	7½	20	37	48	31	Harrowings ... 11
	3		No harrowing ...	1	18 6	5	24	12	1	23	8	49	33	Sohagaings ... 13
	4		Harrowing ...	1	16 6	5	4	10	39	22	11	47	39	Surface harrowings to plots 2 and 4 ... 3
	5		No harrowing ...	2	0	5	29	14	28	22	36	58	32	Surface harrowings to plots 6 and 8 ... 2
	6		Harrowing ...	2	0	5	31	14	27½	23	6	58	30	Date of sowing—15th November 1917.
	7		No harrowing ...	2	0	5	30½	14	8½	23	2	56	34	Date of harvesting—3rd and 4th May 1918.
	8		Harrowing ...	2	0	6	10	12	24	25	0	50	16	

N.B.—The wheat was badly lodged and intensely rusted,

Average yield
per acre.

Md. Srs.

Harrowed ...	...	...	...	22	34
Not harrowed ...	...	...	...	22	20

Statement No. 4.

RESULTS OF DIFFERENT METHODS OF SOWING MAIZE IN ROTATION SERIES AT THE LEALLPUR AGRICULTURAL STATION, KHARIF 1917.

C3	No. of square and plot.	No. of sub-plot.	Name of variety.	Treatment.	Area in acres.	WEIGHT OF DRY STALKS.		WEIGHT OF FRESH COBS.		WEIGHT OF DRY COBS.			WEIGHT OF GRAIN.		YIELD PER ACRE.		REMARKS.
						Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Chataks.	Maunds.	Seers.	Maunds.	Seers.	
27	1	Red local maize.	Lines 2 feet apart ...	1/2	11	29	11	15	9	7	8	7	14	14	28		
28	2		"Kera" sown by hand behind country plough	1/2	14	32	13	27	11	16	0	9	7	18	14		
29	3		Lines 2 feet apart ...	1/2	13	7	15	34	12	13	0	10	6	20	12		
30	4		"Kera" sown by hand behind country plough	1/2	11	20	12	33	10	22	0	8	34	17	28		

Mds. Srs.

Ploughings ...	...	...	...	6	Lines ...	...	...	17	20
Harrowings ...	...	...	...	5	"Kera" ...	...	...	18	1
Sohagaings ...	...	...	...	5					
Bullock hoeings for plots in lines	...	...	...	4					
Khurpa hoeing for plots sown by "Kera"	...	...	...	1					

Date of sowing—30th July 1917.

Date of harvesting—31st October 1917.

Statement No. 5.

DIFFERENT METHODS OF SOWING MAIZE IN TENANTS' AREA, KHARIF 1917.

No. of square and plot.	No. of sub-plot.	Variety.	Treatment.	AREA.		WEIGHT OF DRY COBS.		WEIGHT OF GRAIN.		YIELD OF GRAIN PER ACRE.		REMARKS.
				Kanals.	Marias.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
21	1	Red Local Maize.	Kera behind the country plough ...	2	3	5	1	3	23	13	12	Bullock hoeings three.
	2		Lines 2' apart ...	1	14	4	22	3	10	15	11	
	3		Kera behind the country plough ...	2	3	5	8	3	31	14	1	
	4		Lines 2' apart ...	1	15	4	8	3	6	14	16	
13	1		Kera behind the country plough ...	2	9	3	0	1	37	6	11	Bullock hoeings two.
	2		Lines 2' apart ...	2	9	4	7	2	16	7	33	
	3		Kera behind the country plough ...	2	9	4	30	3	8	10	18	
	4		Lines 2' apart ...	2	9	5	10	3	6	10	11	
16 17	1		Kera behind the country plough ...	2	3	4	0	3	4	11	21	Bullock hoeings three.
	2		Lines 2' apart ...	2	3	5	13	3	38	14	27	
	3		Kera behind the country plough ...	2	3	4	30	3	20	13	1	
	4		Lines 2' apart ...	2	3	5	13	3	30	13	33	

Statement No. 6.

OUTTURN OF SENJI (MELILOTUS PARVIFLORA) GROWN IN SQUARE 27, AREA C, ROTATION SERIES, 1917-18.

No. of square and plot.	No. of sub-plot.	AREA.		ACTUAL OUTTURN.		OUTTURN PER ACRE.		REMARKS.
		Kanals.	Marias.	Maunds.	Seers.	Maunds.	Seers.	
27	1	4	0	111	21	223	2	After maize sown in lines.
	2	4	0	157	16	314	32	After maize sown by kera.
	3	4	0	160	19	320	38	After maize sown in lines.
	4	4	0	117	33	235	26	After maize sown by kera.

Number of waterings—5

Date of sowing—17th October 1917.

Date of harvesting—Plot 1.—20th, 22nd, 26th and 28th February 1918.

Plot 2.—2nd, 6th, 8th and 11th March 1918.

Plot 3.—3rd, 7th, 9th and 12th March 1918.

Plot 4.—21st, 23rd and 27th February and 1st March 1918.

Plot 1 compares with plot 4.

Plot 2 compares with plot 3

Statement No. 7.

OUTTURN OF MAIZE GROWN IN THE MANURIAL BLOCK, AREA D, STANDARD K, SQUARE 27, KHARIF 1917.

No. of plot.	Variety.	Treatment.	Area in acres.	WEIGHT OF FRESH COBS.			WEIGHT OF DRY COBS.			WEIGHT OF DRY STALKS.			WEIGHT OF GRAIN.			YIELD OF GRAIN PER ACRE.			REMARKS.
				Maunds.	Seers.	Chataks.	Maunds.	Seers.	Chataks.	Maunds.	Seers.	Chataks.	Maunds.	Seers.	Chataks.	Maunds.	Seers.	Chataks.	
1	Red local maize.	Unmanured ...	$\frac{37}{1320}$	0	7	0	0	5	0	0	15	0	0	3	8	3	4	14	Ploughings ... 9
2		Super Phosphate at 4 cwt. per acre.	$\frac{1}{4}$	2	10	2	1	32	12	2	11	0	1	12	0	6	20	0	Harrowings ... 10
3		Unmanured ...	$\frac{37}{650}$	0	24	12	0	21	4	1	6	0	0	15	12	7	0	15	Sohagaings ... 12
4		Bone meal at 2 cwt. 94 lbs. per acre.	$\frac{1}{8}$	2	25	12	2	12	0	3	33	0	1	29	0	8	25	0	Hoeings ... 3
5		Unmanured ...	$\frac{37}{650}$	0	11	13	0	10	2	1	10	0	0	7	8	3	13	12	Watering ... 1
6		Farmyard manure at 4 tons per acre.	$\frac{1}{4}$	3	20	0	2	21	0	4	37	0	1	32	0	9	0	0	Date of sowing—6th August 1917.
7		Unmanured ...	$\frac{37}{650}$	0	12	0	0	9	8	1	2	0	0	6	12	3	0	6	Date of harvesting—6th November 1917.
8		Basic slag at 5 maunds 15 seers.	$\frac{1}{8}$	2	23	12	2	6	1	3	0	0	1	23	0	7	35	0	
9		Unmanured ...	$\frac{37}{650}$	0	28	3	0	24	4	1	0	0	0	18	0	8	1	1	
10		Lime at 5 cwt. per acre	$\frac{1}{4}$	3	31	0	3	0	12	3	35	0	2	13	0	11	25	0	
11		Unmanured ...	$\frac{37}{1320}$	0	14	0	0	13	0	0	21	0	0	10	8	9	14	9	

Statement No. 8.

SHOWING THE OUTTURN OF COTTON GROWN IN MANURIAL BLOCK, AREA D, STANDARD K, SQUARE 27, KHARIF 1917.

No. of plot.	Name of variety.	Treatment.	Area in acres.	ACTUAL OUTTURN.			OUTTURN PER ACRE.			REMARKS.
				Maunds.	Seers.	Chataks.	Maunds.	Seers.	Chataks.	
12	Farm selected broad leaved sanguineum cotton.	Unmanured ...	$\frac{37}{1320}$	0	19	4	17	6	12	Ploughings ... 3
13		Calcium cyanamide at 3 cwt. and 2 lbs. per acre.	$\frac{1}{4}$	2	19	11	12	18	7	Harrowings ... 9
14		Unmanured ...	$\frac{37}{650}$	0	23	15	10	26	15	Sohagaings ... 6
15		Calcium nitrate at 5 cwt. and 31 lbs. per acre.	$\frac{1}{4}$	2	16	11	12	3	7	Hoeings ... 10
16		Unmanured ...	$\frac{37}{650}$	0	26	0	11	23	12	Waterings ... 2
17		Farmyard manure at 4 tons per acre	$\frac{1}{4}$	2	18	5	12	11	9	Date of sowing—29th of April 1917.
18		Unmanured ...	$\frac{37}{650}$	0	17	9	12	2	15	Picking began on 21st September 1917 and finished on 27th January 1918.
19		Ammonium sulphate at 3 cwt. 10 lbs. per acre	$\frac{1}{4}$	2	1	5	10	6	9	
20		Unmanured ...	$\frac{37}{650}$	0	26	5	11	29	5	
21		Gypsum at 5 cwt. per acre	$\frac{1}{4}$	2	6	12	10	33	12	
22		Unmanured ...	$\frac{37}{1320}$	0	14	9	12	39	8	

Statement No. 9.

OUTTURN OF SUGARCANE GROWN IN AREA D, STANDARD K, SQUARE 27, KHARIF 1917.

No. of plot.	Variety.	Treatment.	Area in acres.	WEIGHT OF GREEN TOPS.		WEIGHT OF CANE.		WEIGHT OF JUICE.		WEIGHT OF GUR.		YIELD OF GUR PER ACRE.			Percentage of green tops to cane.	Percentage of juice to cane.	Percentage of gur to juice.	Percentage of gur to cane.	REMARKS.
				Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Chataks.	Maunds.	Seers.	Chataks.				
23	Katha.	Unmanured ...	1 $\frac{1}{2}$	3	22	4	25	2	35	0	20	0	17	33	8	76.7	62.1	17.4	10.8
24		Bonemeal at 2 cwt. 94 lbs. and lime at 5 cwt. per acre.	$\frac{1}{2}$	33	27	60	14	31	23	5	10	0	26	10	0	55.8	52.5	16.6	8.7
25		Unmanured ...	1 $\frac{1}{2}$	7	35	14	17	7	0	1	12	8	23	16	7	54.6	48.5	18.7	9.1
26		Lime at 5 cwt., A m, S o, at 3 cwt. 10.2 lb. per acre.	$\frac{1}{2}$	44	1	81	29	42	36	7	30	4	38	31	4	53.9	52.4	18.07	9.4
27		Unmanured ...	1 $\frac{1}{2}$	8	37	13	10	6	35	1	7	0	20	38	6	67.3	51.8	17.09	8.8
28		Farmyard manure at 4 tons per acre.	$\frac{1}{2}$	30	21	60	29	32	21	5	27	8	23	17	8	50.2	53.5	17.4	9.3
29		Unmanured ...	1 $\frac{1}{2}$	9	0	14	23	7	21	1	13	0	23	25	6	61.7	51.6	17.6	9.09
30		Bonemeal at 2 cwt. 94 lbs. lime at 5 cwt. and A m, S o, at 3 cwt. 10.2 lbs. per acre.	$\frac{1}{2}$	43	1	81	36	42	20	7	35	0	39	15	0	52.5	51.8	18.5	9.3
31		Unmanured ...	1 $\frac{1}{2}$	7	16	11	1	5	31	0	35	0	15	24	5	67.1	52.3	15.1	7.9
32		Ca (No. 3) at 5 cwt. 31 lbs., A m, S o, at 3 cwt. 10.2 lbs. and super phosphate at 231 lbs. per acre.	$\frac{1}{2}$	56	31	78	1	39	35	7	26	0	38	10	0	72.7	51.1	19.1	9.7
33		Unmanured ...	1 $\frac{1}{2}$	8	26	12	1	5	31	0	38	0	16	37	13	71.9	48.02	16.4	7.9

Ploughings ... 3
 Harrowings ... 7
 Sohagaings { 7 before sowing.
 { 4 after sowing.

Hoeings ... 10
 Waterings ... 10
 Date of sowing—8th April 1917
 Crushing began on 25th December 1917 and finished on 15th January 1918.

Statement No. 10.

COMPARATIVE TESTS OF WHEAT TYPES 8 A, 11 AND 8 B, RABI 1917-18.

No. of square and plot.	No. of sub-plot.	Name of variety.	Area in acres.	ACTUAL OUTTURN.				OUTTURN PER ACRE.				Previous crop.	REMARKS.
				Grain.		Bhusa		Grain.		Bhusa.			
				Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.		
26 A.	1 a	8 A ...	$\frac{1}{2}$	6	0	11	19	12	0	22	38	Wheat ...	Germination good, but not so nice as in Punjab 11 or 8 B. Rendered thin by white-ants, tillering good. Late in earing.
	1 b	8 A ...	$\frac{1}{2}$	10	13	19	24	20	26	39	8	Do. ...	
	2 a	Punjab type 11 ...	$\frac{1}{2}$	4	25 $\frac{1}{2}$	10	26 $\frac{1}{2}$	9	11.5	21	12.5	Do. ...	Germination good, tillering very fair, slightly attacked by white-ants, rusted and suffered a bit from frost. Early in earing.
	2 b	Punjab type 11 ...	$\frac{1}{2}$	10	1	21	22	20	2	43	4	Do. ...	
	3 a	8 B ...	$\frac{1}{2}$	5	17 $\frac{1}{2}$	11	8 $\frac{1}{2}$	10	35	22	17	Do. ...	Germination good, tillering very fair, slightly attacked by white-ants, rusted and frosted more than Punjab 11 and 8 A. Early in earing.
	3 b	8 B ...	$\frac{1}{2}$	9	27	20	1	19	14	40	2	Do. ...	

N.B.—Plot b₁, b₂, b₃ had an equal amount of lodging to an extent of 2 per cent.

Ploughings ... 5
 Harrowings ... 11
 Sohagaings ... 5
 Surface harrowings and weedings ... 4
 Waterings ... 3

Date of sowing—9th November 1917.

Date of harvesting—25th April to 2nd May 1918.

Statement No. 11.

COMPARATIVE TEST OF WHEAT TYPE 8-A, 11 AND 8-B, RABI 1917-18.

No. of square and plot.	No. of sub-plot.	Variety.	Area in acres.	ACTUAL OUTTURN.				OUTTURN PER ACRE.				Previous crop.	REMARKS.
				Grain.		Bhusa.		Grain.		Bhusa.			
				Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.		
1-a	1-b	8-A	1/2	9	22	18	29	19	4	37	18	Germination good, tillering good, attacked by white-ants, a bit late in earing, rust present, lodging 4 per cent.	
				14	6	34	9	28	12	68	18		Germination good, tillering good, attacked by white-ants, a bit late in earing, rust present, lodging 10 per cent.
2-a	2-b	Punjab-11	1/2	10	22	21	10	21	4	42	20	Cotton ...	Germination good, tillering very fair, slightly attacked by white-ants and frost, rusted near maturity.
				13	4	21	0	26	8	42	0			Germination good, tillering very fair, lodging 1 to 2 per cent., earlier in earing, rusted near maturity.
3-a	3-b	8-B	1/2	9	16	19	21	18	32	39	2	Germination good, tillering fair, slightly attacked by white-ants and frost, paler in colour, slightly rusted, stand good, no lodging.	
				11	10	21	26	22	20	43	12		

Ploughings ... 5
Harrowings ... 18
Sobagaings ... 6
Surface harrowings and weeding 4
Waterings ... 3
Date of sowing—10th November 1917.
Date of harvesting—1st May 1918.

Statement No. 12.

COMPARATIVE TESTS OF WHEAT TYPES 8-A, 11 AND 8-B, RABI 1917-18, IN NEW AREA.

No. of square and block.	No. of plot and sub-plot.	Variety.	Area in acres.	ACTUAL OUT-TURN.				OUTTURN PER ACRE.				Previous crops.	REMARKS.
				Grain.		Bhusa.		Grain.		Bhusa.			
				Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.		
43 A	1 a	8-A ...	$\frac{1}{2}$	8	29	22	3	17	18	44	6	Barley	Germination fair, tillering good, damage by white-ants 12 per cent, slightly rusted in early stage, slightly smutted, one week later in ripening than Punjab 11.
	1 b	8-A ...	$\frac{1}{2}$	8	25	21	35	17	10	43	30		
	2 a	Punjab 11	$\frac{1}{2}$	6	12	15	18	12	24	30	36		Germination and tillering good, damage by white-ants 10 per cent, badly rusted in later stages.
	2 b	Punjab 11	$\frac{1}{2}$	6	1	15	32	12	2	31	24		
	3 a	8-B ...	$\frac{1}{2}$	6	24	19	37	13	8	39	34		Germination good, tillering poor, damage by white-ants 9 per cent, badly rusted in later stages, ripened a bit earlier than Punjab 11.
	3 b	8-B ...	$\frac{1}{2}$	7	21	20	35	15	2	41	30		
	4 a	8-A ...	$\frac{1}{2}$	8	36	20	18	17	32	40	36		Germination fair, tillering good, damage by white-ants 14 per cent, slightly rusted in early stages, slightly smutted, ripened one week later than Punjab 11.
	4 b	8-A ...	$\frac{1}{2}$	8	8	19	24	16	16	39	8		
	5 a	Punjab 11	$\frac{1}{2}$	6	17	14	16	12	34	28	32		Germination and tillering good, damage by white-ants 12 per cent, badly rusted near ripening.
	5 b	Punjab 11	$\frac{1}{2}$	6	5	14	3	12	10	28	6		
	6 a	8-B ...	$\frac{1}{2}$	6	3	14	0	12	6	28	0		Germination good, tillering poor, damage by white-ants 10 per cent, badly rusted near ripening, lodging 2 per cent, in 6b, earlier than Punjab 11.
	6 b	8-B ...	$\frac{1}{2}$	6	38	14	10	13	36	28	20		
	7 a	8-A ...	$\frac{1}{2}$	7	3	14	22	14	6	29	4		Germination fair, tillering good, damage by white-ants 16 per cent, slightly rusted in early stages, slightly smutted, ripened one week later than Punjab 11.
	7 b	8-A ...	$\frac{1}{2}$	5	38	13	18	11	36	26	36		
	8 a	Punjab 11	$\frac{1}{2}$	4	17	9	15	8	34	18	30		Germination and tillering good, damage by white-ants 13 per cent, badly rusted near ripening.
	8 b	Punjab 11	$\frac{1}{2}$	5	14	11	26	10	28	23	12		
	9 a	8-B ...	$\frac{1}{2}$	5	47	11	38	10	34	23	36		Germination good, tillering poor, damage by white-ants 8 per cent, badly rusted near ripening, a bit earlier than Punjab 11.
	9 b	8-B ...	$\frac{1}{2}$	4	36	11	22	9	32	23	4		
Averages.													
Ploughings ...				...	...	...	3						
Harrowings ...				...	...	...	9						
Sohagaings ...				...	...	...	4						
Waterings ...				...	...	...	3						
Surface harrowings ...				...	...	...	5						
Date of sowing—24th-25th of November 1917.													
Date of harvesting—3rd to 10th May 1918.													
		Variety	Area in acres.	Maunds.	Seers.	Maunds.	Seers.						
		8-A ...	3	47	19	15	33						
		Punjab 11.	3	34	26	11	22						
		8-B ...	3	37	19	12	20						

Statement No. 13.

COMPARATIVE VARIETAL TESTS OF WHEATS GROWN IN TENANTS' AREA, RABI 1917-18.

No. of square and kills.	No. of plot.	Name of variety.	AREA.		ACTUAL OUTTURN.		OUTTURN PER ACRE.		Irrigations with dates.	REMARKS.	
			Kanals.	Marlas.	Maunds.	Seers.	Maunds.	Seers.			
3 13	1	Punjab 11 ...	...	4	4	6	6	11	28	Three on— 6th January 1918. 26th February 1918. 19th March 1918.	
	2	8-A ...	...	4	4	6	20	12	15		
7 23	1	Punjab 11 ...	...	4	4	6	30	12	34	Three on— 6th January 1918. 23th February 1918. 23th March 1918.	
	2	8-A ...	...	4	4	8	3	15	15		
12 13	1	Punjab 11 ...	...	4	2	8	25	16	33	Three on— 2nd January 1918. 18th February 1918. 14th March 1918.	
	2	8-A ...	...	4	2	6	20	12	28		
12 14	1	Punjab 11 ...	...	4	1	5	10	10	15	Three on— 2nd January 1918. 18th February 1918. 14th March 1918.	
	2	8-A ...	...	4	1	5	0	9	35		
16 10	1	Punjab 11 ...	...	4	9	5	7	9	12	Three on— 2nd January 1918. 20th February 1918. 14th March 1918.	
	2	8-A ...	...	4	9	5	23	10	0		
16 11	1	Punjab 11 ...	...	4	0	4	0	8	0	Three on— 2nd January 1918. 20th February 1918. 27th March 1918.	
	2	8-A ...	...	4	0	4	20	9	0		
16 15	1	Punjab 11 ...	...	3	15	9	7	19	23	Three on— 21st December 1917. 20th February 1918. 27th March 1918.	
	2	8-A ...	...	3	15	9	10	19	29		
		Average outturn.								Average per acre calculated on yields per acre.	
										Mds.	Srs.
		Punjab 11 ...	...	28	15	45	5	12	22	12	26
		8-A ...	...	28	15	45	16	12	25	12	29

Statement No. 14.

COMPARATIVE VARIETAL TESTS OF WHEATS GROWN IN TENANTS' AREA, RABI 1917-18.

No. of square and killa.	No. of plot.	Name of variety.	AREA.		ACTUAL OUTTURN.		OUTTURN PER ACRE.		Irrigations with dates.	REMARKS.			
			Kanals.	Mails.	Mauds.	Seers.	Mauds.	Seers.					
3 9	1	Punjab 11	...	4	7	3	2	5	24	Four on— 26th December 1917. 20th February 1918. 19th March 1918. 2nd April 1918.			
	2	8-B	...	4	7	5	20	10	4				
3 12	1	Punjab 11	...	4	6	5	10	9	30	Three on— 26th December 1917. 25th February 1918. 19th March 1918.			
	2	8-B	...	4	6	3	22	6	24				
12 7	1	Punjab 11	...	4	10	8	20	15	4	Three on— 3rd January 1918. 18th February 1918. 14th March 1918.			
	2	8-B	...	4	10	6	28	11	36				
12 8	1	Punjab 11	...	4	10	11	35	21	4	Three on— 3rd January 1918. 18th February 1918. 14th March 1918.			
	2	8-B	...	4	10	11	15	20	9				
17 11	1	Punjab 11	...	4	0	9	5	18	10	Three on— 5th January 1918. 25th February 1918. 22nd March 1918.			
	2	8-B	...	4	0	10	5	20	10				
17 20	1	Punjab 11	...	4	8	11	16	20	29	Three on— 21st December 1917. 15th February 1918. 22nd March 1918.			
	2	8-B	...	4	8	13	0	23	25				
17 21	1	Punjab 11	...	4	8	7	4	12	36	Three on— 4th January 1918. 25th February 1918. 22nd March 1918.			
	2	8-B	...	4	8	5	14	9	29				
19 9	1	Punjab 11	...	3	10	9	30	22	11	Three on— 22nd December 1917. 16th February 1918. 14th March 1918.			
	2	8-B	...	3	10	9	0	20	23				
		Average outturn.							Average per acre calculated on yields per acre.				
									Mds.	Srs.			
		Punjab 11	...	33	19	66	2	15	22	15	28		
		8-B	...	33	19	64	24	15	8	15	15		

Statement No. 15.

COMPARATIVE VARIETAL TESTS OF WHEATS GROWN IN TENANTS' AREA, RABI 1917-18.

No of square and killa.	No. of plot.	Name of variety.	AREA.		ACTUAL OUTTURN.		OUTTURN PER ACRE.		Irrigations with dates.	REMARKS.	
			Kanals.	Marias.	Maunds.	Seers.	Maunds.	Seers.			
7 18	1	Punjab 17	...	4	6	4	35	9	2	Three on— 7th January 1918. 26th February 1918. 28th March 1918.	
	2	Pusa 12	...	4	6	6	10	11	25		
7 19	1	Punjab 17	...	4	5	9	10	17	16	Three on— 7th January 1918. 26th February 1918. 28th March 1918.	
	2	Pusa 12	...	4	5	10	0	18	33		
13 7	1	Punjab 17	...	4	10	11	10	20	...	Three on— 21st December 1917. 19th February 1918. 14th March 1918.	
	2	Pusa 12	...	4	10	12	20	22	9		
16 16	1	Punjab 17	...	4	2	4	23	8	37	Three on— 21st December 1917. 20th February 1918. 27th March 1918.	
	2	Pusa 12	...	4	2	5	18	10	25		
19 11	1	Punjab 17	...	3	14	5	11	11	16	Three on— 4th January 1918. 25th February 1918. 14th March 1918.	
	2	Pusa 12	...	3	19	6	6	12	18		
19 12	1	Punjab 17	...	3	10	6	17	14	27	Three on— 4th January 1918. 25th February 1918. 14th March 1918.	
	2	Pusa 12	...	3	10	8	6	18	25		
19 13	1	Punjab 17	...	4	16	11	25	19	15	Three on— 22nd December 1917. 25th February 1918. 14th March 1918.	
	2	Pusa 12	...	4	16	10	34	18	3		
Average outturn										Average per acre calculated on yields per acre.	
									Mds.	Srs.	
		Punjab 17	...	29	3	53	11	14	24	14	16
		Pusa 12	...	29	8	59	14	16	6	16	2

17 suffered in having poorer germination in most cases.

17 suffered in having poorer germination in most cases.

Statement No. 16.

COMPARATIVE VARIETAL TESTS OF WHEATS GROWN IN TENANTS, AREA, RABI 1917-18.

Number of square and killa.	Number of plot.	Name of variety.	AREA.		ACTUAL OUTTURN.		OUTTURN PER ACRE.		Irrigations with dates.	REMARKS.
			Kanals.	Marlas.	Maunds.	Seers.	Maunds.	Seers.		
5 10	1	Punjab-11 ...	4	9	12	34	23	5	Three on— 21st December 1917. 18th February 1918. 27th March 1918.	
	2	17-B ...	4	9	11	22	20	31		
5 11	1	Punjab-11 ...	4	7	12	30	23	18	Three on— 21st December 1917. 18th February 1918. 27th March 1918.	
	2	17-B ...	4	7	8	38	16	18		
13 10	1	Punjab-11 ...	4	7	13	10	24	15	Three on— 21st December 1917. 19th February 1918. 14th March 1918.	
	2	17-B ...	4	7	12	0	22	3		
13 11	1	Punjab-11 ...	3	19	11	25	23	21	Three on— 21st December 1917. 19th February 1918. 14th March 1918.	
	2	17-B ...	3	19	9	20	19	10		
13 15	1	Punjab-11 ...	3	18	11	8	22	39	Three on— 21st December 1917. 19th February 1918. 27th March 1918.	
	2	17-B ...	3	18	10	26	21	34		
		Average outturn.							Average per acre calculated on yields per acre.	
									Maunds.	Seers.
		Punjab-11 ...	21	0	61	27	23	19	23	19
		17-B ...	21	0	52	26	20	3	20	3

Statement No. 17.

COMPARATIVE VARIETAL TESTS OF WHEATS GROWN IN TENANTS' AREA, RABI 1917-18.

No. of square and killa.	No. of plot.	Name of variety.	AREA.		ACTUAL OUTTURN.		OUTTURN PER ACRE.		Irrigations with dates.	REMARKS.	
			Kanals.	Marlas.	Maunds.	Seers.	Maunds.	Seers.			
11 8	1	Punjab-11 ...	3	16	8	35	8	6	4 on— 5th December 1917. 17th February 1918. 13th March 1918. 27th March 1918.	Germination and tillering good. Rust appeared earlier in 9 C. Both badly rusted in later stages, 9 C being the worst. Lodging was very bad in 9 C throughout.	
	2	9 C ...	3	16	4	30	10	0			
11 9	1	Punjab-11 ...	4	0	10	10	20	20	3 on— 18th December 1917. 17th February 1918. 27th March 1918.		
	2	9 C ...	4	0	8	5	16	10			
17 22	1	Punjab-11 ...	4	6	7	36	14	28	3 on— 21st December 1917. 15th February 1918. 22nd March 1918.		
	2	9 C ...	4	6	7	10	13	20			
17 23	1	Punjab-11 ...	4	2	7	26	14	37	3 on— 21st December 1917. 15th February 1918. 13th March 1918.		
	2	9 C ...	4	2	6	10	12	8			
17 24	1	Punjab-11 ...	3	19	11	0	22	11	3 on— 21st December 1917. 15th February 1918. 22nd March 1918.		
	2	9 C ...	3	19	7	35	15	38			
		Average outturn.							Average per acre calculated on yields per acre.		
		Punjab-11 ...	20	3	40	27	16	6	Maunds. Seers. 16 5		
		9 C ...	20	3	34	10	13	23	13 23		

Statement No. 18.

RESULTS OF DIFFERENT NUMBER OF WATERINGS WITH WHEAT TYPES PUNJAB-11 AND PUSA-12, RABI 1917-18.

TWO WATERINGS.										THREE WATERINGS.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
No. of square and block.	No. of plot and sub-plot.	Variety.	AREA.		OUTTURN PER ACRE.				REMARKS.	No. of square and block.	Number of plot and sub-plot.	Variety.	AREA.		OUTTURN PER ACRE.				REMARKS.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
			Kanales.	Marlas.	Mounds.	Seers.	Grain.	Bhusa.					Mounds.	Seers.	Grain.	Bhusa.	Mounds.	Seers.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
1a	1a	Punjab-11 ...	4	0	8	21	23	16	Germination and tillering good, damage by white ants 10 per cent., slightly rusted in early stages and badly near ripening.	32	1b	Punjab-11 ...	4	0	12	18	32	4	Germination and tillering good, damage by white ants 10 per cent., slightly rusted in early stages, but badly near ripening.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														

Date of sowing.—7th December 1917.

Date of harvesting.—4th to 10th May 1918.

Ploughings ... 8

Harrowings ... 8

Sohagings ... 4

Surface Harrowings ... 3

Statement No. 19.

OUTTURN OF 4-F AMERICAN COTTON GROWN IN SQUARE 26, KHARIF 1917.

No. of plot.	No. of sub-plot.	Treatment.	Area in acres.	ACTUAL OUTTURN.			OUTTURN PER ACRE.			Irrigation in inches after sowing.	REMARKS.
				Maunds.	Seers.	Chataks.	Maunds.	Seers.	Chataks.		
A-1	1 a	Drilled on flat, ridged afterwards with ordinary irrigation.	$\frac{1}{2}$	2	31	10	5	23	4	12.83	
	1 b	Ditto ...	$\frac{1}{2}$	3	14	12	6	29	8		
	2 a	Drilled on flat with ordinary irrigation.	$\frac{1}{2}$	2	28	8	5	17	0	12.37	
	2 b	Ditto ...	$\frac{1}{2}$	3	20	5	7	0	10		
	3 a	Drilled on flat, ridged afterwards, heavier irrigation at longer intervals.	$\frac{1}{2}$	2	34	7	5	23	14	14.99	
	3 b	Ditto ...	$\frac{1}{2}$	3	33	2	7	23	4		

Ploughings ... 3

Harrowings ... 6

Sohagaings ... 10

Hoeings ... 14

Ridge making in plot 1 and 3... 3

Waterings ... 4

Date of sowing—30th March 1917.

Picking began on 12th October 1917 and finished on 27th January 1918.

Statement No. 20.

RESULTS OF HYDRAULIC EXPERIMENTS WITH FARM SELECTED BROADLEAF SANGUINEUM COTTON GROWN IN SQUARE 10, KHARIF 1917.

No. of square and plot.	No. of sub-plot.	Treatment.	AREA.		ACTUAL OUTTURN.		OUTTURN PER ACRE.		Irrigation in inches before sowing.	Irrigation in inches after sowing.	REMARKS.
			Kanals.	Marias.	Maunds.	Seers.	Maunds.	Seers.			
10 A ₁ , a	1	Ordinary cultivation with 8 kharis per acre cotton drilled in lines 2'—4" apart.	2	0	2	7	8	23	3.4"	3.7"	Average on plots in lines = 9 maunds 36 seers.
	2		2	0	2	12	9	8	3.4"	3.9"	
	3		2	0	2	26	10	24	3.4"	3.6"	Average on flat = 7 maunds 11 seers.
	4		2	0	2	31	11	4	3.4"	3.4"	
10 A ₂ , a	1	Ordinary cultivation with 8 kharis per acre, cotton sown broadcast.	2	0	1	23	6	12	3.7"	2.83"	
	2		2	0	1	22	6	8	3.98"	4.20"	
	3		2	0	1	37	7	23	3.6"	4.20"	
	4		2	0	2	9	8	36	3.7"	4.41"	

Ploughings ... 2

Harrowings ... 3

Sohagaings ... 3

Hoeings in A₁, a ... 14—Hoeing with desi plough in A₂, a = 1.

Watering ... 1 and surface harrowing with harrow = 1.

Date of sowing—22nd April 1917.

Picking began on 22nd September 1917 and finished on 29th January 1918.

Statement No. 21.

OUTTURN OF 4 F. AMERICAN COTTON, KHARIF 1917.

No. of square and block.	No. of plot.	No. of sub-plot.	Treatment.	AREA.		ACTUAL OUTTURN.		OUTTURN PER ACRE.		Irrigation in inches after sowing.	REMARKS.	
				Kanals.	Marlas.	Maunds.	Seers.	Maunds.	Seers.			
32 B	4	a	Drilled in lines 3' apart	...	2	0	8	10	13	0	6.82	Watered in June and July.
		d			2	0	2	13	9	12		
		b	Sown broadcast	...	2	0	2	39	11	36		
		c			2	0	2	19	9	36		
32 B	5	a	Drilled in lines 3' apart	...	2	0	3	27	14	28	9.72	Watered in May, June and July.
		d			2	0	3	10	13	0		
		b	Sown broadcast	...	2	0	2	36	11	24		
		c			2	0	2	22	10	8		
32 B	6	a	Drilled in lines 3' apart	...	2	0	1	30	7	0	3.5	Not watered in May and June.
		d			2	0	2	0	8	0		
		b	Sown broadcast	...	2	0	2	4	8	16		
		c			2	0	2	28	10	32		

Ploughings 3
Harrowings 2
Sohagaings 2

Hoeings—Bullock hoeings to plots in lines 9, 10, 8, respectively. The broadcasted portions were hoed once with the Desi plough.

Date of sowing—20th April 1917.

Picking began on 3rd November 1917, and finished on 6th February 1918.

Average outturn per acre.

	Maunds.	Seers.
Lines	10	33
Broadcast	10	18

Statement No. 22.

SHOWING RESULTS OF SOWING COTTON IN LINES *VERSUS* BROADCAST WITH TENANTS AT THE LYALLPUR AGRICULTURAL STATION, KHARIF 1917.

No. of square and plot.		BROADCAST.										No. of square and plot.		No. of sub-plot.		LINES.										REMARKS.
		Area.		Actual outturn.				Outturn per acre.								Area.		Actual outturn.				Outturn per acre.				
				Kanals.	Maunds.	Seers.	Chataks.	Maunds.	Seers.	Chataks.	Maunds.							Seers.	Chataks.	Kanals.	Maunds.	Seers.	Chataks.			
13	1	2	0	2	0	14	8	3	8	13	2	0	2	17	15	9	31	12	12	Broadcast received three waterings on 30th June, 20th July and 5th November 1917, and intercultured once with the desi plough on 28th August 1917.						
14	3	2	0	2	5	2	8	20	8	13	4	0	2	17	3	9	28	12	12							
13	1	2	4	2	4	2	7	25	14	13	2	4	3	12	11	12	2	8	8	Line plots received two waterings on 20th July and 5th November 1917, and hoed 8 times on 10th, 18th and 29th May, 7th and 24th June, 14th, 23rd and 28th July 1917.						
14	3	2	4	1	15	11	5	2	8	17	4	4	2	35	9	10	20	3	3							
13	Total ...	8	8	7	25	13	7	11	4	...	...	8	11	3	6	10	22	4	4							
17	Average outturn per acre.	...	...	...	...	...	...	...	1½	...	...	...	...	...	...	10	20	12	12							
19	1	1	12	0	38	8	4	7	8	19	2	17	2	27	8	11	24	14	14	Broadcast received one watering on 18th July 1917 and intercultured once with the desi plough on 21st July 1917.						
1	8	1	17	1	8	0	5	7	9	19	4	17	2	20	8	10	34	9	9							
1	1	1	16	2	37	0	13	0	0	20	2	16	3	18	7	15	15	4	4	Line plots received one watering on 18th July 1917 and 8 hoeings on 10th, 25th and 29th May, 6th, 12th and 20th June and 14th and 21st July 1917.						
20	3	1	16	3	0	10	13	16	1	5	4	16	2	39	2	13	9	7	7							
5	Total ...	7	1	7	39	2	9	2	2	...	...	6	11	25	9	12	30	3	3							
	Average outturn per acre.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...							
	GRAND TOTAL	15	9	15	24	15	8	3	9	...	...	14	22	28	15	11	23	2	2							
	Average outturn per acre.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...							

Statement No. 23.

SHOWING RESULTS OF HYDRAULIC EXPERIMENTS WITH FARM SELECTED BROAD LEAF SANGUINEUM COTTON GROWN IN SQUARE 10, KHARIF 1917.

No. of square and plot.	No. of sub-plot.	Treatment.	AREA.		ACTUAL OUTTURN.		OUTTURN PER ACRE.		Irrigation in inches before sowing.	Irrigation in inches after sowing.	REMARKS.
			Kanals.	Marlas.	Maunds.	Seers.	Maunds.	Seers.			
10 A ₁ b	1	Watered in May, June and July	2	0	1	22	6	6	3.4	8.67	Watered in July only.
	2	Not watered in May and June	2	0	1	38	7	32	3.35	3.17	
	3	Watered in May, June and July	2	0	1	32	7	8	3.4	9.24	
	4	Not watered in May ...	2	0	1	29	6	36	3.4	8.72	
10 A ₂ b	1	Not watered in May and June ...	1	0	0	33	6	24	3.7	3.34	Average outturn per acre. Mds. Srs. 3 waterings 6 21 2 waterings 6 36 1 watering 7 8
	2	Watered in May, June and July	2	0	1	22	6	8	3.7	9.32	
	3	Not watered in May ...	2	0	1	29	6	36	4.1	7.43	
	4	Watered in May, June and July	2	0	1	25	6	20	3.2	9.22	

Ploughings ... 2

Harrowings ... 4

Sohagaings ... 3

Date of sowing—23rd to 26th April 1917.

Picking began on 22nd September 1917 and finished on 29th January 1918.

N.B.—On account of copious rains, no irrigation was necessary after the month of July.

Statement No. 24.

OUTTURN OF 4-F AMERICAN COTTON GROWN IN SQUARE 32, BLOCK B, YEAR 1917-18.

No. of plot.	No. of sub-plot.	Treatment.	AREA.		ACTUAL OUTTURN.		OUTTURN PER ACRE.		Irrigation in inches after sowing.	REMARKS.
			Kanals.	Marlas.	Maunds.	Seers.	Maunds.	Seers.		
1	a	Not watered in May ...	2	0	2	31	11	4	5.92	All drilled in lines 8' apart. Average yield per acre. Srs. Mds. 3 waterings 10 13 2 waterings 11 35 1 watering 10 2
	b		2	0	3	13	13	12		
	c		2	0	2	25	10	20		
	d		2	0	3	6	12	24		
2	a	Watered in May, June and July	2	0	2	30	11	0	8.47	
	b		2	0	2	37	11	28		
	c		2	0	2	21	10	4		
	d		2	0	2	4	8	16		
3	a	Not watered in May and June...	2	0	2	26	10	24	3.18	
	b		2	0	3	7	12	28		
	c		2	0	2	4	8	16		
	d		2	0	2	5	8	20		

Ploughings ... 3

Harrowings ... 2

Sohagaings ... 2

Bullock hoeings 11, 13 and 10, respectively.

Date of sowing—21st April 1917.

Picking began on 3rd November 1917 and finished on 5th February 1918.

Statement No. 25.

SHOWING THE COMPARATIVE RESULTS OF AMERICAN COTTON VARIETIES GROWN WITH TENANTS AT LYALLPUR AGRICULTURAL STATION, KHARIF 1917.

No. of square and plot.	No. of sub-plot.	Variety.	AREA.		Soil.	ACTUAL OUT-TURN.			OUT TURN PER ACRE.			No. of hoeings with dates.	Irrigations with dates.	REMARKS.
			Kanals.	Masals.		Maunds.	Seers.	Chataks.	Maunds.	Seers.	Chataks.			
3	1	4-F	1	16	Calcareous loam.	1	39	10	8	34	0	Seven on— 14th May 1917. 29th May 1917. 7th June 1917. 20th June 1917. 11th July 1917. 15th July 1917. 27th July 1917.	Two on— 7th June 1917. 8th August 1917.	Ridges made on 27th July 1917.
	2	280-F	1	16		1	35	13	8	17	0			
	3	4-F	1	16		1	34	13	8	13	8			
	4	280-F	1	16		1	22	1	6	35	12			
6	1	4-F	2	2	Calcareous loam.	1	34	14	7	5	4	Eight on— 13th May 1917. 22nd May 1917. 30th May 1917. 6th June 1917. 20th June 1917. 13th July 1917. 28th July 1917. 30th August 1917.	Three on— 9th July 1917. 8th August 1917. 25th October 1917.	
	2	280-F	2	2		1	23	10	6	2	6			
	3	4-F	2	2		2	2	15	7	36	0			
	4	280-F	2	2		1	38	5	7	13	5			
7	1	4-F	1	19	Calcareous loam.	1	25	8	6	28	11	Seven on— 9th May 1917. 10th May 1917. 29th May 1917. 6th June 1917. 20th June 1917. 14th July 1917. 29th July 1917.	Three on— 17th June 1917. 7th July 1917. 8th August 1917.	Root Rot bad in first three plots, comparatively slight damage in 4th plot. Ridged on 14th July 1917.
	2	280-F	1	19		1	32	14	7	19	0			
	3	4-F	1	18		2	24	4	10	38	15			
	4	280-F	2	0		2	14	12	9	19	0			
10	1	4-F	1	19	Calcareous loam.	1	36	6	7	33	5	Six on— 5th May 1917. 13th May 1917. 21st May 1917. 6th June 1917. 17th June 1917. 15th July 1917.	Three on— 9th July 1917. 8th August 1917. 23rd October 1917.	
	2	280-F	1	19		1	36	13	7	35	2			
	3	4-F	1	19		2	5	10	8	31	4			
	4	280-F	1	19		1	36	8	7	33	13			
13	1	4-F	1	18	Heavy loam	3	11	6	13	33	2	Eight on— 1st May 1917. 2nd May 1917. 28th May 1917. 6th June 1917. 18th June 1917. 30th June 1917. 5th July 1917. 16th July 1917.	Four on— 27th April 1917. 12th July 1917. 29th July 1917. 20th October 1917.	
	2	280-F	1	18		2	28	8	11	16	13			
	3	4-F	1	18		3	3	3	12	38	10			
	4	280-F	1	18		2	11	6	9	24	11			
17	1	4-F	2	4	Heavy loam	2	37	0	10	25	8	Six on— 13th May 1917. 24th May 1917. 6th June 1917. 19th June 1917. 22nd June 1917. 18th July 1917.	Two on— 14th July 1917. 25th October 1917.	
	2	280-F	2	4		3	4	12	11	13	10			
	3	4-F	2	4		3	14	6	12	8	10			
	4	280-F	2	4		3	5	1	11	14	12			
20	1	4-F	1	18	Medium loam	2	25	8	11	4	3	Seven on— 10th May 1917. 25th May 1917. 7th June 1917. 13th June 1917. 14th June 1917. 25th June 1917. 21st July 1917.	Three on— 8th July 1917. 25th October 1917. 7th November 1917.	
	2	280-F	1	18		2	15	11	10	2	14			
	3	4-F	1	18		2	30	15	11	27	2			
	4	280-F	1	18		2	21	1	10	25	8			
20	1	4-F	2	0	Medium and sandy loam.	2	30	3	11	0	12	Eleven on— 7th May 1917. 10th May 1917. 25th May 1917. 29th May 1917. 6th June 1917. 15th June 1917. 25th June 1917. 16th July 1917. 21st July 1917. 29th July 1917. 31st August 1917.	Two on— 1st July 1917. 25th July 1917.	
	2	280-F	2	0		2	0	13	8	3	4			
	3	4-F	2	0		1	11	4	5	34	4			
	4	280-F	1	15										

AVERAGE OUTTURN PER ACRE.

AVERAGE OUTTURN PER ACRE CALCULATED ON YIELD PER ACRE.

		Total area.	Total yield.			Yield per acre.					
									Maunds.	Seers.	Chataks.
4-F	31	11	38	37	6	9	34	14	9	35	1
280-F	31	8	34	21	5	8	31	14	8	30	4

No. of square and plot.	No. of sub-plot.	Name of variety.	AREA.		Soil.	ACTUAL OUT-TURN.			OUTTURN PER ACRE.			Number of hoeings with dates.	Irrigations with dates.	REMARKS.																								
			Kanals.	Marlas.		Maunds.	Seers.	Chataks.	Maunds.	Seers.	Chataks.																											
3 24	1	4-F	1	19	Medium loam.	3	2	3	12	21	6	Seven on— 10th May 1917. 14th May 1917. 22nd May 1917. 29th May 1917. 7th June 1917. 20th June 1917. 12th July 1917.	Four on— 7th July 1917. 8th September 1917. 25th October 1917. 11th November 1917.																									
	2	275-F	1	19		3	6	10	12	39	7																											
	3	4-F	1	19		2	36	11	11	38	11																											
	4	275-F	1	19		3	8	11	13	8	0																											
6 2	1	4-F	2	3	Calcareous loam.	1	28	7	6	14	10	Eight on— 7th May 1917. 22nd May 1917. 30th May 1917. 6th June 1917. 19th June 1917. 14th July 1917. 28th July 1917. 30th August 1917.	Three on— 8th July 1917. 8th August 1917. 25th October 1917.																									
	2	275-F	2	3		1	15	12	5	7	7																											
	3	4-F	2	3		1	20	15	5	26	11																											
	4	275-F	2	3		1	28	0	6	13	0																											
20 2	1	4-F	2	2	Sandy loam.	2	12	8	8	32	6	Seven on— 14th May 1917. 24th May 1917. 7th June 1917. 24th June 1917. 4th July 1917. 16th July 1917. 30th August 1917.	Three on— 29th June 1917. 22nd July 1917. 26th October 1917.																									
	2	275-F	2	2		2	8	2	8	15	11																											
	3	4-F	1	6		1	2	9	6	21	14																											
	4	275-F	0	12		0	19	10	6	21	11																											
19 19	1	4-F	1	15	Heavy loam.	2	19	12	11	16	0	Ten on— 13th May 1917. 23rd May 1917. 29th May 1917. 7th June 1917. 13th June 1917. 20th June 1917. 16th July 1917. 23rd July 1917. 30th July 1917. 1st September 1917.	Two on— 17th July 1917. 26th October 1917.																									
	2	275-F	1	15		2	26	13	12	8	4																											
	3	4-F	1	15		2	22	2	11	26	13																											
	4	275-F	1	15		2	32	3	12	32	13																											
19 22	1	4-F	1	12	Heavy loam.	2	0	6	10	1	14	Eight on— 13th May 1917. 23rd May 1917. 29th May 1917. 6th June 1917. 20th June 1917. 16th July 1917. 21st July 1917. 31st July 1917.	Two on— 17th July 1917. 26th October 1917.																									
	2	275-F	1	12		1	33	5	9	6	9																											
	3	4-F	1	12		2	24	11	13	3	7																											
	4	275-F	1	12		2	31	4	13	36	4																											
AVERAGE OUTTURN PER ACRE. Total area. AVERAGE OUTTURN PER ACRE CALCULATED ON YIELD PER ACRE. Total yield. Maunds. Seers. Chataks.																																						
<table border="0" style="width: 100%;"> <tr> <td style="width: 33%;">4-F</td> <td style="width: 10%;">18</td> <td style="width: 10%;">6</td> <td style="width: 10%;">22</td> <td style="width: 10%;">10</td> <td style="width: 10%;">4</td> <td style="width: 10%;">9</td> <td style="width: 10%;">29</td> <td style="width: 10%;">2</td> <td style="width: 10%;">9</td> <td style="width: 10%;">32</td> <td style="width: 10%;">8</td> </tr> <tr> <td>275-F</td> <td>17</td> <td>12</td> <td>22</td> <td>10</td> <td>6</td> <td>10</td> <td>4</td> <td>11</td> <td>10</td> <td>2</td> <td>14</td> </tr> </table>															4-F	18	6	22	10	4	9	29	2	9	32	8	275-F	17	12	22	10	6	10	4	11	10	2	14
4-F	18	6	22	10	4	9	29	2	9	32	8																											
275-F	17	12	22	10	6	10	4	11	10	2	14																											

Statement No. 27.

COMPARATIVE RESULTS OF AMERICAN COTTON VARIETIES GROWN WITH TENANTS AT LYALLPUR
AGRICULTURAL STATION, KHARIF, 1917.

No. of square and plot.	No. of sub-plot.	Variety.	AREA.		Soil.	ACTUAL OUTTURN.			OUTTURN PER ACRE.			No. of hoeings with dates.	Irrigations with dates.	REMARKS.			
			Kanals.	Marias.		Maunds.	Seers.	Chataks.	Maunds.	Seers.	Chataks.						
7 14	1	4-F ...	2	1	Medium loam.	3	16	3	13	11	7	Eight on— 7th May 1917. 10th May 1917. 22nd May 1917. 29th May 1917. 7th June 1917. 12th June 1917. 14th July 1917. 30th July 1917	Two on— 7th July 1917 ... 8th August 1917.	Ridges made on 30th July 1917.			
	2	Risala, American...	2	1		3	11	9	12	38	6						
	3	4-F ...	2	1		3	19	11	13	25	2						
	4	Risala, American .	2	1		3	25	15	14	9	8						
20 8	1	4-F ...	1	19	Medium loam.	2	29	14	11	10	12	Six on— 15th May 1917. 25th May 1917. 7th June 1917. 17th July 1917. 29th July 1917. 30th August 1917.	Two on— 12th July 1917. 26th October 1917.				
	2	Risala, American...	1	19		2	13	15	9	25	6						
	3	4-F ...	1	19		2	16	15	9	37	11						
	4	Risala, American...	1	16		1	36	1	8	27	11						
AVERAGE OUTTURN PER ACRE.																	
Total area.			Total yield.			Yield per acre.			Maunds.			Seers.			Chataks.		
4-F ...			8	0	...	12	2	11	12	2	11	12	1	4			
Risala, American...			7	16	...	11	7	8	11	19	0	11	13	15			

Statement No. 28.

RESULTS OF COMPARATIVE SOWING OF AMERICAN VERSUS DESI COTTON WITH TENANTS AT LYALLPUR
AGRICULTURAL STATION, KHARIF, 1917.

No. of square and plot.	No. of sub-plot.	Name of variety.	AREA.		Soil.	ACTUAL OUTTURN.			OUTTURN PER ACRE.			No. of hoeings with dates.	Irrigations with dates.	REMARKS.			
			Kanals.	Marias.		Maunds.	Seers.	Chataks.	Maunds.	Seers.	Chataks.						
16 8	1	4-F ...	2	5	Heavy loam	2	0	14	7	7	8	Seven on— 12th May 1917. 31st May 1917. 6th June 1917. 20th June 1917. 2nd July 1917. 15th July 1917. 5th August 1917.	Two on— 29th June 1917. 29th July 1917.				
	2	Rosea No. 87 ...	2	5		2	20	13	8	38	7						
	3	4-F ...	2	5		2	24	12	9	12	7						
	4	Rosea No. 87 ...	2	5		3	1	4	10	31	1						
16 13	1	4-F ...	2	1	Heavy loam	2	16	4	9	15	9	Eight on— 12th May 1917. 21st May 1917. 28th May 1917. 6th June 1917. 20th June 1917. 2nd July 1917. 14th July 1917. 5th August 1917.	Two on— 30th June 1917. 29th July 1917.				
	2	Rosea No. 87 ...	2	1		2	16	14	9	18	0						
	3	4-F ...	2	1		2	30	8	10	31	3						
	4	Rosea No. 87 ...	2	1		2	17	14	9	22	0						
AVERAGE OUTTURN PER ACRE.															AVERAGE OUTTURN PER ACRE CALCULATED ON YIELDS PER ACRE.		
Total area.			Total outturn.			Yield per acre.			Maunds.			Seers.			Chataks.		
4-F ...			8	12	...	9	32	6	9	5	0	9	6	11			
Rosea No. 87 ...			8	12	...	10	16	13	9	27	12	9	27	6			

Statement No. 29.

COMPARATIVE RESULTS OF DESI COTTON VARIETIES GROWN WITH TENANTS AT LYALLPUR AGRICULTURAL STATION, KHARIF 1917.

No. of square and plot.	No. of sub-plot.	Name of variety.	AREA.		Soil.	ACTUAL OUTTURN.		OUTTURN PER ACRE.		No. of hoeings with dates.	Irrigations with dates.	REMARKS.																	
			Kanals.	Marsals.		Mounds.	Seers.	Chataks.	Mounds.				Seers.	Chataks.															
3	1	Rosea No. 87	1	8	Medium loam ...	1	16	4	8	1	7	Eight on— 14th May 1917 29th May 1917 7th June 1917 20th June 1917. 30th June 1917. 14th July 1917. 30th July 1917. 31st August 1917. Six on— 11th May 1917 22nd May 1917. 30th May 1917. 6th June 1917. 18th June 1917. 14th July 1917. Six on— 10th May 1917 28th May 1917 6th June 1917 19th June 1917. 16th July 1917. 28th July 1917. Six on— 14th May 1917 31st May 1917. 6th June 1917. 17th June 1917. 22nd June 1917. 17th July 1917. Seven on— 14th May 1917 31st May 1917 6th June 1917 11th June 1917. 4th July 1917. 14th July 1917. 4th August 1917.	Three on— 28th June 1917. 8th August 1917. 26th October 1917.	...															
	2	Mollisoni No. 24	1	26		11	9	21	1	...																			
	3	Rosea No. 87	1	3		0	6	6	11	...																			
	4	Mollisoni No. 24	1	25		1	9	11	13	...																			
6	1	Rosea No. 87	1	18	Medium to heavy loam	2	17	8	10	10	8	One on— 23th July 1917.	...																
	2	Mollisoni No. 24	1	18		3	6	10	13	2	...																		
	3	Rosea No. 87	1	18		2	23	2	11	6	14			...															
	4	Mollisoni No. 24	1	18		3	13	12	14	3	2			...															
7	1	Rosea No. 87	2	8	Calcareous loam with kallar patches.	1	36	9	6	15	4	Two on— 9th July 1917. 8th August 1917.	...																
	2	Mollisoni No. 24	2	8		2	29	13	9	6	0			...															
	3	Rosea No. 87	2	8		2	7	1	7	10	4			...															
	4	Mollisoni No. 24	2	8		3	3	7	10	11	7			...															
17	1	Rosea No. 87	2	2	Medium to heavy loam	2	19	4	9	18	1	One on— 13th July 1917.	...																
	2	Mollisoni No. 24	2	2		3	0	9	11	19	4			...															
	3	Rosea No. 87	2	2		2	12	0	8	30	8			...															
	4	Mollisoni No. 24	2	2		3	9	13	12	14	8			...															
12	1	Rosea No. 87	1	10	Calcareous loam	1	28	10	9	6	0	Three on— 28th June 1917. 28th July 1917. 20th October 1917.	...																
	2	Mollisoni No. 24	1	10		1	37	11	10	14	5			...															
	3	Rosea No. 87	1	11		1	25	2	8	16	2			...															
	4	Mollisoni No. 24	1	11		1	36	9	9	35	2			...															
AVERAGE OUTTURN PER ACRE.						AVERAGE OUTTURN WORKED ON YIELDS PER ACRE.																							
Total area.						Total outturn.						Yield per acre.																	
						19						8						20						1					
						25						11						33						15					

Statement No. 30.

SHOWING THE COMPARATIVE RESULTS OF DESI COTTON VARIETIES GROWN WITH TENANTS AT THE LYPLPUR AGRICULTURAL STATION, KHARIF 1917.

No. of square and plot.	No. of sub-plot.	Variety.	Area.		Soil.	Actual Outturn.		Outturn per Acre.			No. of hoeings with dates.	Irrigations with dates.	Remarks.		
			Kanals.	Mails.		Mauds.	Seers.	Chataks.	Mauds.	Seers.				Chataks.	
5	1	Rosea No. 87	...	4	Heavy loam	1	31	10	6	20	7	Six on— 15th May 1917. 5th June 1917. 19th June 1917. 5th July 1917. 15th July 1917. 6th August 1917.	Two on— 28th June 1917. 28th July 1917.		
	2	Indicum No. 135	...	4		1	8	13	4	17	8				
	3	Rosea No. 87	...	4		2	6	6	7	34	2				
	4	Indicum No. 135	...	4		1	17	3	5	8	0				
12	1	Rosea No. 87	...	18	Medium loam	2	39	8	12	23	2	Six on— 11th May 1917. 22nd May 1917. 6th June 1917. 12th June 1917. 19th June 1917. 16th July 1917.	Two on— 9th June 1917. 9th July 1917.		
	2	Indicum No. 135	...	18		1	39	15	8	16	9				
	3	Rosea No. 87	...	18		3	15	2	14	8	15				
	4	Indicum No. 135	...	18		2	6	6	9	3	11				
12	1	Rosea No. 87	...	9	Calcareous loam	1	11	13	7	5	13	Seven on— 14th May 1917. 1st June 1917. 7th June 1917. 19th June 1917. 4th July 1917. 14th July 1917. 5th August 1917.	Four on— 29th May 1917. 29th June 1917. 28th July 1917. 20th October 1917.		
	2	Indicum No. 135	...	9		1	5	9	6	11	6				
	3	Rosea No. 87	...	9		1	5	10	6	11	11				
	4	Indicum No. 135	...	9		0	33	14	4	27	0				
12	5	Rosea No. 87	...	9	Ditto	1	8	10	6	28	5	Seven on— 14th May 1917. 1st June 1917. 7th June 1917. 19th June 1917. 4th July 1917. 14th July 1917. 5th August 1917.	Four on— 29th May 1917. 29th June 1917. 28th July 1917. 20th October 1917.		
	1	Indicum No. 135	...	10		1	15	10	7	16	10				
	2	Rosea No. 87	...	10		1	30	3	9	14	5				
	3	Indicum No. 135	...	10		1	14	14	7	12	10				
16	1	Rosea No. 87	...	2	Heavy loam	3	29	1	14	7	13	Six on— 12th May 1917. 21st May 1917. 28th May 1917. 5th June 1917. 18th June 1917. 14th July 1917.	One on— 29th July 1917.		
	2	Indicum No. 135	...	2		2	31	4	10	23	13				
	3	Rosea No. 87	...	2		3	21	4	13	18	1				
	4	Indicum No. 135	...	2		2	12	13	8	33	9				
AVERAGE OUTTURN PER ACRE.															
Total area.						Total outturn.						Yield per acre.			
...						...						...			
18						22						10			
18						16						7			
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Statement No. 31.

COMPARATIVE RESULTS OF DESI COTTON VARIETIES GROWN WITH TENANTS AT THE LYALLPUR AGRICULTURAL STATION, KHARIF 1917.

No. of square and plot.	No. of sub-plot.	Name of variety.	AREA.		Soil.	ACTUAL OUTTURN.			OUTTURN PER ACRE.			No. of hoeings with dates.	Irrigations with dates.	REMARKS.
			Kanals.	Marlas.		Maunds.	Seers.	Chataks.	Maunds.	Seers.	Chataks.			
7 22	1	Rosea, No. 87 ...	2	1	Calcareous loam.	1	23	9	6	8	0	Six on— 14th May 1917 6th June 1917 19th June 1917 14th July 1917 28th July 1917 30th August 1917	Two on— 8th July 1917. 8th August 1917.	
	2	Neglectum, No. 109	2	1		1	14	13	5	13	14			
	3	Rosea, No. 87 ...	2	1		1	21	7	5	39	12			
	4	Neglectum, No. 109	2	1		1	23	12	6	8	12			
12 4	3	Rosea, No. 87 ...	1	11	Calcareous loam.	1	23	12	8	9	0	Seven on— 14th May 1917 31st May 1917 5th June 1917 18th June 1917 4th July 1917 14th July 1917 4th August 1917.	Three on— 28th June 1917 28th July 1917 20th October 1917.	
	4	Neglectum, No. 109	1	11		1	13	5	6	35	2			
12 5	5	Rosea, No. 87 ...	1	11	Calcareous loam.	1	31	5	9	8	1	Five on— 9th May 1917 29th May 1917 7th June 1917 18th June 1917 14th July 1917	Two on— 9th July 1917. 29th September 1917.	
	1	Neglectum, No. 109	1	5		0	36	11	5	34	12			
6 16	1	Rosea, No. 87 ...	1	18	Calcareous loam.	2	8	6	9	12	1	Five on— 9th May 1917 29th May 1917 7th June 1917 18th June 1917 14th July 1917	Two on— 9th July 1917. 29th September 1917.	
	2	Neglectum, No. 109	1	18		1	30	12	7	17	14			
	3	Rosea, No. 87 ...	1	18		2	13	3	9	32	6			
	4	Neglectum, No. 109	1	18		2	...	8	8	18	15			
AVERAGE OUTTURN PER ACRE.														
Total area.			Total yield.			Yield per acre.			AVERAGE OUTTURN PER ACRE CALCULATED ON YIELDS PER ACRE.					
									Maunds		Seers		Chataks.	
Rosea, No. 87.			11	...		11	1	10	8	1	3	8	4	14
Neglectum, No. 109			10	14		8	39	13	6	29	0	6	28	3

Statement No. 32 [summary.]

OUTTURN OF COTTON VARIETIES TESTED ON TENANTS AREA, KHARIF 1917.

Serial No.	Variety.	AREA.		ACTUAL OUTTURN.			OUTTURN PER ACRE.			Year of handing over to the Lyallpur Agricultural Station.	REMARKS.
		Kanals.	Marlas.	Maunds.	Seers.	Chataks.	Maunds.	Seers.	Chataks.		
1	4-F ...	31	11	33	37	6	9	34	14	1910	
2	280-F ...	31	8	34	21	5	8	31	14	1913	
3	4-F ...	18	6	22	10	4	9	29	2	1910	
4	275-F ...	17	12	22	10	6	10	4	11	1913	
5	4-F ...	8	0	12	2	11	12	2	11	1910	
6	Bisala American ...	7	16	11	7	8	11	19	0	1917	
7	4-F ...	8	12	9	32	6	9	5	0	1910	
8	Rosea, No. 87 ...	8	12	10	16	3	9	27	1	1914	
9	Rosea, No. 87 ...	18	13	19	31	8	8	19	8	1914	
10	Mollisoni, No. 24 ...	18	13	25	30	0	11	1	13	1914	
11	Rosea, No. 87 ...	18	5	22	39	3	10	3	1	1914	
12	Indicum, No. 135-A ...	18	6	16	26	5	7	11	4	1914	
13	Rosea, No. 87 ...	11	0	11	1	10	8	1	3	1914	
14	Neglectum, No. 109 ...	10	14	8	39	13	6	29	0	1916	

Statement No. 33.

OUTTURN OF TORIA GROWN IN SQUARE 26, 1917-18.

No. of square and plot.	No. of sub-plot.	Name of crop.	Previous crop.	Treatment.	Area in acres.	ACTUAL OUTTURN.						YIELD OF GRAIN PER ACRE.			REMARKS.		
						Grain.			Straw.			Maunds.	Seers.	Chataks.			
						Maunds.	Seers.	Chataks.	Maunds.	Seers.	Chataks.						
26 — 1 A 2	a ₁	Torla.	Wheat.	Ordinary operations of sowing ...	...	4	2	1	8	3	3	0	8	6	0		
	a ₂			Do. + Bar harrow in addition ...	...	4	2	8	8	3	22	0	8	34	0		
	b ₁			Ordinary operations of sowing ...	...	4	3	10	10	5	5	0	13	2	8		
	b ₂			Do. + Bar harrow in addition ...	...	4	3	24	8	5	35	0	14	18	0		
26 — 2 A 2	a ₁			Ordinary operations of sowing ...	...	4	2	1	0	4	10	0	8	4	0		
	a ₂			Do. + Bar harrow in addition ...	...	4	2	9	8	4	25	0	8	38	0		
	b ₁			Ordinary operations of sowing ...	...	4	3	19	0	6	2	0	13	36	0		
	b ₂			Do. + Bar harrow in addition ...	...	4	4	1	6	7	18	0	16	5	8		
26 — 3 A 2	a ₁			Ordinary operations of sowing ...	...	4	2	11	0	4	25	0	9	4	0		
	a ₂			Do. + Bar harrow in addition ...	...	4	2	19	0	4	29	0	9	36	0		
	b ₁			Ordinary operations of sowing ...	...	4	3	14	8	5	38	0	13	18	0		
	b ₂			Do. + Bar harrow in addition ...	...	4	3	15	0	6	7	0	13	20	0		

Ploughings ...	...	...	...	4
Harrowings ...	...	...	...	7
Sohagaings ...	...	...	...	1
Waterings ...	...	...	...	2
Date of sowing—15th September 1917.				
Date of harvesting—6th to 9th January 1918.				
Average of ordinary plots ...	...	10	Maunds.	Seers.
„ harrowed plots ...	...	11		38

Statement No. 34.

OUTTURN OF TORIA GROWN IN SQUARE 32, BLOCK C, KHARIF 1917.

No. of plot.	No. of sub-plots	AREA.		ACTUAL OUTTURN.			YIELD PER ACRE.			REMARKS.
		Kanals.	Marias.	Maunds.	Seers.	Chataks.	Maunds.	Seers.	Chataks.	
1	a	4	0	5	12	8	10	25	0	The usual method of sowing Toria was adopted throughout the area. Plots marked b were treated with the Bar harrow worked immediately after sowing, while the portions marked a were left untreated.
	b	4	0	5	7	6	10	14	12	
2	a	4	0	6	13	4	12	26	8	
	b	4	0	7	23	8	15	7	0	
3	a	4	0	6	37	0	13	34	0	
	b	4	0	6	28	0	13	16	0	
4	a	4	0	7	6	5	14	12	10	
	b	4	0	6	23	8	13	7	0	
5	a	4	0	6	2	0	12	4	0	
	b	4	0	6	9	8	12	19	0	
6	a	4	0	6	23	8	13	7	0	
	b	4	0	6	27	0	13	14	0	

Ploughings ...	...	...	...	4
Harrowings ...	...	...	...	4
Sohagaings ...	...	...	...	3
Waterings ...	...	...	...	3
Date of sowing—16th September 1917.				
Date of harvesting—4th to 18th February 1918.				
Average of (a)	12	31	Maunds.	Seers.
„ (b)	12	39		

Statement No. 35.

RESULT OF HYDRAULIC EXPERIMENTS WITH TORIA GROWN IN SQUARE 10, KHARIF 1917 (EARLY SOWN).

No. of square and plot.	No. of sub-plot.	Treatment.	AREA.		ACTUAL OUTTURN.				OUTTURN PER ACRE.				Irrigation in inches before sowing.	Irrigation in inches after sowing.	REMARKS.
			Kanals.	Maunds.	Grain.		Straw.		Grain.		Straw.				
					Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.			
10 B ₁ a	1	Ordinary cultivation, two irrigations.	2	1	7	4	2	4	28	16	8	Sown after rains.	5-14	The land under this plot tends to be inferior.	
	2	Ordinary cultivation, one irrigation.	2	2	4	6	3	8	16	24	12		2-57		
	3	Ordinary cultivation, two irrigations.	2	3	1	7	37	12	4	31	28		5-40		
	4	Ordinary cultivation, one irrigation.	2	3	0	7	22	12	0	30	8		2-57		
10 B ₂ a	1	Ordinary cultivation, two irrigations.	2	1	36	5	16	7	24	21	24	Sown after rains.	4-38		
	2	Ordinary cultivation, one irrigation.	2	1	33	5	32	7	12	23	8		2-44		
	3	Ordinary cultivation, two irrigations.	2	2	8	5	38	8	32	23	32		4-38		
	4	Ordinary cultivation, one irrigation.	2	2	16	6	14	9	24	25	16		2-44		

Ploughings 4
 Harrowings 9
 Sohagaings 2
 Date of sowing—14th and 15th September 1917.
 Date of harvesting—9th to 12th January 1918.

Average yield per acre.
 Two irrigations ... Mds. Srs.
 One irrigation ... 8 12
 ... 9 13

Statement No. 36.

RESULT OF HYDRAULIC EXPERIMENTS WITH TORIA GROWN IN SQUARE 10, 1917 (LATE SOWN).

No. of square and plot.	No. of sub-plot.	Treatment.	AREA.		ACTUAL OUTTURN.				OUTTURN PER ACRE.				Irrigation in inches after sowing.	REMARKS.
			Kanas.	Marlas.	Grain.		Straw.		Grain.		Straw.			
					Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.		
10 C ₁ a	1	Ordinary cultivation, two irrigations.	2	0	1	30	8	5	7	0	32	20	5.79	
	2	Ordinary cultivation, one irrigation.	1	14 $\frac{118}{121}$	1	0	4	24	4	22	21	1	3.16	
	3	Ordinary cultivation, two irrigations.	2	0	1	2	5	2	4	8	20	8	5.69	
	4	Ordinary cultivation, one irrigation.	2	0	0	29	4	34	2	36	19	16	3.09	
10 C ₂ a	1	Ordinary cultivation, two irrigations.	2	0	1	34	7	33	7	16	31	12	5.94	
	2	Ordinary cultivation, one irrigation.	2	0	1	20	6	15	6	0	25	20	3.31	
	3	Ordinary cultivation, two irrigations.	2	0	1	11	6	1	5	4	24	4	3.14	
	4	Ordinary cultivation, one irrigation.	1	16 $\frac{10}{121}$	1	5	6	15	4	38	28	19	3.31	

Ploughings 4
 Harrowings 10
 Sohagaings 2
 Date of sowing—3rd October 1917.
 Date of harvesting—14th and 20th February 1918.

Average yield per acre.
 Two irrigations ... Mds. Srs.
 One irrigation ... 5 37
 ... 4 24

N.B.—The crop was badly attacked by aphid and also affected by frost.

Statement No. 37,

RESULTS OF HYDRAULIC EXPERIMENTS WITH WHEAT GROWN IN SQUARE 10, RABI 1917-18 (EARLY SOWN).

No. of plot.	No. of sub-plot.	Treatment.	AREA.	ACTUAL OUTTURN.				OUTTURN PER ACRE.				Irrigation in inches before sowing.	Irrigation in inches after sowing.	REMARKS.
				Grain.		Bhusa.		Grain.		Bhusa.				
				Kanals.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.				Seers.
B ₁ b	1	2 kiaries, ordinary cultivation, surface harrowing—3 waterings.	2	4	1	8	14	16	4	33	16	3-39	6-0	Germination good, tillering fair, damage by white-ants 5 per cent., growth heavier towards khal, attacked by rust, lodging 1 per cent.
	2	Ditto—2 waterings	2	3	33	6	16	15	12	25	24	3-3	5-12	Germination and tillering good, damage by white-ants 11 per cent., growth thin, rusted in later stages.
	3	Ditto—3 waterings	2	3	12	7	22	13	8	30	8	3-39	7-9	Germination good, tillering fair, damage by white-ants 6 per cent., affected by frost, growth thin, rusted as in No. 2.
	4	Ditto—2 waterings	2	4	8	6	31	16	32	27	4	3-57	5-32	Germination good, tillering fair to good, damage by white-ants 12 to 15 per cent., growth fair and uniform, rusted as in Nos. 2 and 3.
B ₂ b	1	Ditto—3 waterings	2	2	11	3	32	9	4	15	8	3-19	6-98	Germination fair, tillering poor, damage by white-ants 8 per cent., growth poor, badly rusted.
	2	Ditto—2 waterings	2	1	37	3	11	7	28	13	4	3-19	4-88	Germination fair to good, tillering poor to fair, damage by white-ants 14 per cent., growth thin, badly rusted.
	3	Ditto—3 waterings	2	3	12	6	38	13	8	27	32	3-27	7-17	Germination and tillering good, damage by white-ants 4-5 per cent., growth uneven, rusted as above.
	4	Ditto—2 waterings	2	4	17	7	28	17	28	30	32	3-27	5-13	Germination and tillering good, damage by white-ants 12 to 15 per cent., growth fair and uniform, rusted badly in later stages.
Ploughings				...	...	...	...	5	Rust appeared after the 1st of March 1918, and the plots with poor tillering and thin growth suffered the most.					Mds. Srs.
Harrowings				...	...	...	...	15	Land varies and tends to be better towards plot No. 4 in both fields.					
Sohagaings				...	...	...	...	5						
Surface harrowings and weedings { plots Nos. 1 and 3				...				4						
Date of sowing—30th October 1917.				plots Nos. 2 and 4				5						
Date of harvesting—29th April 1918.									Average of 3 waterings					...
									" 2 "					...
														12 36
														14 15

Statement No. 38.

RESULTS OF HYDRAULIC EXPERIMENTS WITH WHEAT GROWN IN SQUARE 10, RABI 1917-18 (LATE SOWN).

No. of square and plot.	No. of sub-plot.	Treatment.	AREA.	ACTUAL OUTTURN.				OUTTURN PER ACRE.				Irrigation in inches before sowing.	Irrigation in inches after sowing.	REMARKS.	
				Kanals.	Grain.		Bhusa.		Grain.		Bhusa.				
					Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.				Seers.
10 C ₁ b	1	2 kairis, ordinary cultivation, surface harrowing—2 waterings.	2	1	19	3	19	5	36	13	36	3-09	8-34	Crop late sown, germination fair, crop thin, condition below average, intensively rusted.	
	2	Ditto—2 waterings	2	1	28	3	24	6	32	14	16	2-92	4-98		
	3	Ditto—3 do.	2	1	31	4	35	7	4	19	20	2-92	8-61		
	4	Ditto—2 do.	2	2	28	7	12	10	32	29	8	3-09	4-88		
10 C ₂ b	1	Ditto—3 do.	2	1	27	4	18	6	28	17	32	3-22	7-50		
	2	Ditto—2 do.	2	1	29	4	11	6	36	17	4	2-61	4-88		
	3	Ditto—3 do.	2	2	8	5	32	8	32	23	8	3-31	7-50		
	4	Ditto—2 do.	2	2	2	6	9	8	8	24	36	3-31	4-88		

Ploughings 5
Harrowings 14
Sohagaings 4
Surface harrowings 3

Date of sowing—11th December 1917.

Date of harvesting—6th May 1918.

Statement No. 39 (a).

EFFECT OF COMPARATIVE GREEN MANURING ON WHEAT GROWN IN AREA A, SQUARE 2, RABI 1917-18.

No. of square and plot.	No. of sub-plot.	Treatment,	AREA.		ACTUAL OUTTURN.				OUTTURN PER ACRE.				REMARKS.
					Grain.		Bhusa.		Grain.		Bhusa.		
			Kanals.	Marlas.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
2 A	21	San buried in, on 7th September 1917.	2	0	1	31	2	31	7	4	11	4	
	22	Guara ditto ditto	2	0	2	4	3	10	8	16	13	0	
	23	San ditto ditto	4	2	1	22	5	27	3	1	11	3	
	24	Indigo ditto ditto	4	2	1	22	3	19	3	1	6	31	
	25	San ditto ditto	4	3	1	18	3	33	2	32	7	15	
	26	Mung ditto ditto	4	3	0	38	2	31	1	33	5	14	
	27	San ditto ditto	4	1	1	8	3	10	2	15	6	16	
	28	Mash ditto ditto	4	1	0	29	3	1	1	17	5	39	
	29	San ditto ditto	4	5 $\frac{1}{2}$	1	18	2	38	2	28	5	20	
	30	Moth ditto ditto	4	5 $\frac{1}{2}$	1	28	4	13	3	7	8	2	

Ploughings 2
 Harrowings 2
 Sohagaings 3
 Waterings 3
 Surface harrowings 2
 Date of sowing,—30th November 1917.
 Date of harvesting,—6th and 7th May 1918.

Statement No. 39 (b).

RESIDUAL EFFECT OF COMPARATIVE GREEN MANURING ON WHEAT GROWN IN AREA A, SQUARE 2, RABI 1917-18.

No. of square and plot	No. of sub-plot.	Treatment.	AREA.		ACTUAL OUTTURN.				OUTTURN PER ACRE.				REMARKS.
			Kanals.	Marlas.	Grain.		Bhusa.		Grain.		Bhusa.		
					Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
2 A	11	Residue of San buried in, on 14th September 1916.	4	8½	2	38	4	6	5	13	7	20	Germination good, tillering poor, crop poor and thin, badly rusted
	12	Do. of Moth, ditto	4	8½	1	29	7	34	3	5	14	9	Germination and tillering fair, crop poor and thin.
	13	Do. of Mash, ditto	4	3½	2	16	5	6	4	24	9	25	Ditto ditto.
	14	Do. of San, ditto	4	3½	2	6	7	13	4	5	14	3	Ditto ditto.
	15	Do. of San, ditto	4	5¾	2	30	5	25	5	6	10	2	Ditto ditto.
	16	Do. of Mung, ditto	4	5¾	2	12	6	20	4	12	12	7	Ditto ditto.
	17	Do. of San, ditto	4	4½	2	27	6	24	5	3	12	21	Ditto ditto.
	18	Do. of Indigo, ditto	4	4½	2	15	5	36	4	20	11	8	Ditto ditto.
	19	Do. of San, ditto	2	0	0	19	1	6	1	36	4	24	Germination good, tillering fair, crop thin rusted badly.
	20	Do. of Guara, ditto	2	0	0	33	1	38	3	12	7	32	Germination good, tillering fair, to good, crop poor, rusted badly.

Ploughings 3
 Harrowings 13
 Sohagaings 5
 Waterings 3
 Surface harrowings 2
 Date of sowing,—8th December 1917.
 Date of harvesting,—6th and 9th May 1918.

Statement No. 39 (c).

RESIDUAL EFFECT OF COMPARATIVE GREEN MANURING ON WHEAT GROWN IN AREA A, SQUARE 2, RABI 1917-18.

No. of square and plot.	No. of sub-plot.	Treatment.	AREA.		ACTUAL OUTTURN.				OUTTURN PER ACRE.				REMARKS.
			Kanas.	Masas.	Grain.		Bhusa.		Grain.		Bhusa.		
					Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
2 A	1	Residue of San buried in, on 22nd September 1915.	2	0	0	18	1	18	1	32	5	32	
	2	Do. of Guara, ditto	2	0	0	19	2	0	1	36	8	0	
	3	Do. of San, ditto	3	16	1	30	3	31	3	27	7	38	
	4	Do. of Indigo, ditto	3	16	2	29	6	8	5	29	13	2	
	5	Do. of San, ditto	3	17½	2	28	6	2	5	23	12	21	
	6	Do. of Mung, ditto	3	17½	3		4	10	6	8	8	32	
	7	Do. of San, ditto	3	15½	0	36	3	34	1	36	8	7	
	8	Do. of Mash, ditto	3	15½	1	12	2	2	2	30	4	14	
	9	Do. of San, ditto	3	19½	1	34	6	8	3	29	12	18	
	10	Do. of Moth, ditto	3	19½	2	18	5	11	4	37	10	23	

Ploughings ... 3
 Harrowings ... 13
 Sohagaings ... 4
 Waterings ... 3
 Surface harrowings ... 2

Date of sowing—30th November 1917.

Date of harvesting—7th May 1918.

Statement No. 40.

EFFECT OF GREEN MANURING ON WHEAT GROWN IN AREA C, SQUARE 2, RABI 1917-18.

No. of square and plot.	No. of sub-plot.	Treatment.	AREA.		ACTUAL OUTTURN.				OUTTURN PER ACBE.				REMARKS.
			Kanas.	Masas.	Grain.		Bhusa		Grain.		Bhusa.		
					Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
2 C	1	San buried in 6" deep, on 18th September 1917.	7	8½	8	26	16	2	9	11	17	9	Germination good, tillering poor, crop uneven, rusted in later stages.
	2	Fallow ...	7	10½	15	0	33	30	15	36	35	31	Germination and tillering good, growth vigorous rusted.
	3	San buried in 9" deep, on 19th and 20th September 1917.	7	9½	10	21	19	10	11	10	20	24	Germination good, tillering poor, growth poor but better in kallar patches, rusted.
	4	Fallow ...	7	11½	9	33	18	10	10	15	19	11	Germination good, tillering fair to poor, crop uneven, badly rusted.

DETAILS OF CULTIVATION.

For 1 and 3 For 2 and 4.

Ploughings ... 2 6
 Harrowings ... 2 6
 Sohagaings ... 4 6
 Waterings ... 3 3
 Surface harrowings... 4 4

Date of sowing—23rd November 1917.

Date of harvesting—30th April 1918 and 4th May 1918.

Statement No. 41.

SHOWING RESULTS OF GREEN MANURING WITH WHEAT IN TENANTS' AREA, RABI 1917-18.

No. of square, Killa and Plot.	Treatment.	AREA.		ACTUAL OUTTURN		OUTTURN PER ACRE.		No. of square, Killa and Plot.	Treatment.	AREA.		ACTUAL OUTTURN		OUTTURN PER ACRE.		REMARKS.
		Kanals.	Marlas.	Maunds.	Seers.	Maunds.	Seers.			Kanals.	Marlas.	Maunds.	Seers.	Maunds.	Seers.	
13	San buried in, on 17th September 1917 ...	4	10	8	10	14	26	13	Guara buried in, on 17th September 1917 ...	4	10	10	20	18	26	
19								19								
13		4	6	6	18	12	...	13		4	6	9	2	16	33	
20	San buried in, on 18th September 1917 ...	4	8	5	30	11	3	13	Guara removed on 18th September 1917 ...	4	8	4	8	8	3	
21								21								
13		4	6	7	0	13	1	13		4	6	5	8	9	27	
22								22								

Ploughings	...	...	...	2	Average yield per acre—	
Sohagaings	...	...	...	2	San ploughed in	13 13
Waterings	...	...	...	4	Guara ploughed in	17 30
Surface harrowings	...	...	...	3	San ploughed in	12 2
Date of sowing—16th and 17th November 1917.					Guara removed	8 35
Date of harvesting—29th April 1918.						

Statement No. 42.

RESULTS OF MANURIAL AND VARIETY EXPERIMENTS WITH SUGAR CANE IN TENANTS' AREA, YEAR 1917-18.

No. of square and plot.		Variety of cane.	Treatment.	AREA.		WEIGHT OF GREEN TOPS.		WEIGHT OF CANE.		WEIGHT OF JUICE.		WEIGHT OF GUR.		YIELD OF GUR PER ACRE.		Percentage of green tops to cane.	Percentage of juice to cane.	Percentage of gur to juice	Percentage of gur to cane.	REMARKS.
No. of sub plot.				Kanals.	Marlas.	Maun ds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.						Chataks.
13	1	Katha...	Farmyard manure at 15 tons per acre.	1	1	25	38	63	23	37	8	6	3	46	11	7	40-81	58-51	16-33	9-55
16	2	Kansar		1	1	26	31	59	25	37	8	6	2	46	3	13	44-9	62-38	16-26	10-14
	3	Katha...	Farmyard manure at 15 tons and mahowa cake at 15 maunds per acre.	1	1	30	28	60	11	34	36	5	30	43	32	6	50-93	57-90	16-47	9-53
	4	Kansar		0	15	19	9	43	30	25	30	4	4	43	29	5	43-94	58-85	15-92	9-37
	5	Lalri ...	Farmyard manure at 15 tons per acre.	1	1	24	27	58	25	32	22	5	13	40	22	14	42-08	55-52	16-35	9-08
	6	Katha ...		0	16	20	8	41	34	23	10	3	26	36	20	0	48-26	55-55	15-69	8-72
	7	Lalri ...	Farmyard manure at 15 tons and mahowa cake at 15 maunds per acre.	1	1	20	37	58	27	32	1	5	16	41	5	11	35-66	54-53	16-86	9-20
	8	Katha...		1	1	29	12	62	37	35	16	5	38	45	13	5	46-56	56-25	16-80	9-45

Ploughings	...	...	...	...	...	2
Harrowings	...	...	...	...	...	1
Sohagaings	...	...	...	...	...	2
Waterings	...	...	...	...	...	10
Hoeings and harrowings	...	...	...	...	...	5

Date of sowing 3rd April 1917.

Crushing began on 6th December 1917.

Crushing finished on 25th December 1917.

Statement No. 43.

RESULTS OF MANURIAL AND VARIETY EXPERIMENTS WITH SUGAR CANE IN TENANTS' AREA, YEAR 1917-18.

No. of square and plot.	No. of sub-plot.	Variety of cane.	Treatment.	Area.		Weight of green tops.		Weight of cane.		Weight of juice.		Weight of gur.		Yield of gur per acre.		Percentage of green tops to cane.	Percentage of juice to cane.	Percentage of gur to juice.	Percentage of gur to cane.	Remarks.
				Kanals.	Masals.	Mounds.	Seers.	Mounds.	Seers.	Mounds.	Seers.	Mounds.	Seers.	Mounds.	Seers.					
1	1	Katha	Farmyard manure at 15 tons and mahowa cake at 15 maunds per acre.	1	2	33	28	49	39	25	32	4	30	34	21	13	67.43	51.62	18.41	9.50
2	1	Do.	Farmyard manure at 15 tons per acre	1	2	26	13	53	13	28	10	4	32	34	36	6	49.36	52.97	16.99	9.001
3	1	Ialri	Farmyard manure at 15 tons per acre	1	2	27	38	64	26	34	5	6	0	43	25	7	43.23	52.78	17.58	9.28
4	1	Do.	Farmyard manure at 15 tons and mahowa cake at 15 maunds per acre.	1	2	27	31	58	6	84	4	0	0	43	25	7	47.76	58.64	17.59	10.31
5	0	Katha	Farmyard manure at 15 tons per acre	0	16	20	32	37	25	19	37	3	26	36	20	0	55.28	52.95	18.32	9.70
6	1	Do.	Farmyard manure at 15 tons and mahowa cake at 15 maunds per acre.	1	2	38	7	58	38	27	21	4	34	35	10	14	56.27	46.69	17.62	8.22
7	1	Lalri	Farmyard manure at 15 tons and mahowa cake at 15 maunds per acre.	1	2	26	3	56	29	30	19	5	16	39	10	14	45.93	53.72	17.71	9.51
8	0	Do.	Farmyard manure at 15 tons per acre	0	18	21	24	43	36	24	21	4	20	40	0	0	49.03	55.86	18.34	10.25

Ploughings ... 2
Harrowings ... 2
Sohagings ... 8
Waterings ... 10
Weeding and hoeing ...
Date of sowing—3rd April 1917.
Crushing— { began on 25th January 1918.
{ finished on 4th February 1918.

Statement No. 44.

RESULTS OF CALCIUM NITRATE ON WHEAT GROWN IN SQUARE 7, RABI 1917-18.

[illegible]

Ploughings
Harrowings
Sohagangs
Waterings
Surface harrowings
Date of sowing—18th November 1917.
Date of harvesting—6th-7th May 1918,

Statement No. 45.

HOT WEATHER CULTIVATION *VERSUS* RAIN PLOUGHING IN TENANTS' AREA, RABI 1917-18.

HOT WEATHER PLOUGHING.

No. of square.	No. of plot.	Type of wheat.	AREA.		ACTUAL OUTTURN.				OUTTURN PER ACRE.				REMARKS.
			Kanals.	Marlas.	Grain.		Bhusa.		Grain.		Bhusa.		
					Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
6	7	Punjab 11 ...	9	2	11	17	23	5	10	1	20	13	Ploughed on 13th May 1917.
6	9	Ditto ...	8	17	10	28	18	20	9	27	16	29	Ditto.
6	11	Ditto ...	7	2	10	33	15	5	12	7	17	2	Ploughed on 14th May 1917.
6	13	Ditto ...	8	1	7	32	17	11	7	30	17	7	Ditto.

Mds. s. c.

Average yield per acre ...

9 36 4

RAIN PLOUGHING.

No. of square.	No. of plot.	Type of wheat.	AREA.		ACTUAL OUTTURN.				OUTTURN PER ACRE.				REMARKS.
			Kanals.	Marlas.	Grain.		Bhusa.		Grain.		Bhusa.		
					Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
6	8	Punjab 11 ...	8	12	10	37	21	29	10	6	20	8	Ploughed on 12th August 1917.
6	10	Ditto ...	7	11	11	6	19	2	11	32	20	7	Ditto.
6	12	Ditto ...	8	7	15	10	22	19	14	24	21	21	Ploughed on 9th August 1917.
6	14	Ditto ...	8	11	15	26	28	33	14	25	26	38	Ditto.

Mds. s. c.

Average yield per acre ...

12 31 12

Ploughings ... 3

Harrowings ... 4

Waterings ... 3

Surface harrowings ... 3

Date of sowing—21st to 24th November 1917.

Date of harvesting—1st to 4th May 1918,

Dates of rainfall—

1st May 1917	...	03	18th June 1917	...	036	27th July 1917	...	38	17th August 1917	...	31
3rd "	...	03	19th "	...	021	1st August 1917	...	12	18th "	...	12
11th "	...	16	1st July 1917	...	008	4th "	...	10	19th "	...	175
12th "	...	05	2nd "	...	030	9th "	...	83	23rd "	...	15
13th "	...	02	12th "	...	108	10th "	...	120	24th "	...	18
29th "	...	15	25th "	...	84	13th "	...	11	25th "	...	47
3rd June 1917	...	194	26th "	...	11	14th "	...	112	26th "	...	02
						15th "	...	23	27th "	...	04
									31st "	...	22

APPENDIX VII.

Report of the Officiating Deputy Director of Agriculture on Gurdaspur Farm.

Introductory.—I was in charge of this farm throughout the year under report. For brief history and objects of the farm please see last year's report. The farm has this year been extended by another 57 acres for wheat varietal tests.

Season (statement 1), and its effects upon crops.—The total rainfall during the year (July 1st, 1917 to June 30th, 1918) was 53·37" as compared with 30·86" in the preceding year which was almost the normal (34·5") of the district. The rains began early, were heavy and continuous, with the result that the soil was oversaturated during the growing period of kharif crops (a condition which is very injurious for agriculture, especially in badly drained places); which were very weedy for want of any inter-cultivation as they could not be got at, being almost always very wet. All kharif crops consequently suffered badly. Root system was generally undeveloped and sugarcane and bajra lodged very badly; whereas maize failed to give a fair germination.

The fallow rabi fields too could not be handled and received little cultivation during summer. Rains stopped on 25th September and the season was practically dry till 27th October, when there was 6·33" of rain. This delayed sowings and spoiled the early sown crops. Rabi accordingly had generally to be sown on ill-prepared seedbeds, but with plenty of moisture in the soil, within very easy reach of the roots. This resulted naturally in meagre root development and poor tillering and consequently a thin crop. This weather, moreover, influenced the soil temperature, which was very much cooled down and for want of optimum conditions of temperature in the seedbed germination was delayed and scanty to a certain extent. After this heavy shower in the end of October the season remained almost absolutely dry during the growth of the crop till the second half of March; when there was 2·8" of rain which was a very great help to the needy crops. It further cooled down the rising temperature and thus allowed a better development of the grain which otherwise would have ripened all at once or rather shrivelled by the western hot winds which generally set in early April. But unfortunately it was followed by very heavy wind which lodged most of the well grown and early crops.

Winter this year was not very severe and did not affect sugarcane, but was severe and dry enough to tell upon the weak plants and retard their growth in the case of wheat. There was of course plenty of moisture in the soil, but the roots were shallow and could not get it from below to ward off this attack; hence its severity.

The late sowings and March and April showers delayed harvesting by some ten days than usual.

Crop pests.—There was an attack of mites on sugarcane, but did no serious damage. Behar caterpillar appeared in innumerable numbers in September and totally destroyed mash and til. Late rust also caused some slight damage to wheat.

Rotations, details of experiments, etc.—Please see last year's report.

Crops.—Kharif.—Sugarcane (statement 2). The crop was put in rather late, as the pump which had been sent to Amritsar, was not received back in time. The rain in the end of April 1917 was very harmful, and not only delayed but affected the germination of the crop—especially of our three best varieties Behar, Yuba and Sonabli, which were rather on a low bit. These varieties had consequently a very thin germination. The monsoon was very heavy and was very often accompanied by heavy winds, which caused a good deal of lodging in the varieties which had escaped the harmful effect of April rains and had made a fairly good growth. The rains, moreover, were so constant and continuous that no interculture could be done and the crop was full of weeds and grasses. All these things had a very bad effect on the crop and reduced the outturns considerably.

There were 12 varieties under test besides the local Dhauru, six of these have been discarded and only six (Behar, Yuba, Sonabli, Suretha, Dhauru of Azamgarh and Burli) kept on. They have all their good points, and it will now be sometimes before any further selection can be done among these six. They are heavy yielders and do particularly well in particular localities. J 105 and J 33 did fairly well this year and have been brought into regular tests. J 33 has a weak point in being susceptible to red rot, and I am not sure that for this fault alone it will have to be discarded. However, it is being given a fair chance to see if by selection of healthy sets we can produce a healthy type.

Twenty-two New Canes—17 from the Imperial Sugarcane Expert, Coimbatore, 3 from Manjri and 2 from Shahjahanpur Farm—are being grown for the first time this year.

Manurial experiments with sugarcane.—Please see last year's report.

Maize.—The varietal tests were continued. This in fact was the first year of regular tests with this crop. The varieties under test were (1) Peshawari; (2) Jaunpore; (3) Kangra red; (4) Kangra white; (5) Sargodha; (6) American and (7) local. The heavy rains interfered with the germination and spoiled the crop. The results consequently are not worth discussing.

Cotton.—Economic Botanist's environment experiment is being conducted.

Other kharif crops on the farm were mash, til, bajra, soybeans and groundnuts, all of which more or less suffered from the heavy rains and bad drainage. Mash and til suffered from the ravages of Behar (hairy) caterpillar too.

Bajra.—The long-headed variety of bajra which has been introduced from this farm has become very popular with the growers. It was not a single pure type, but a mixture of hairy and smooth varieties, which both were separated and are being tested against each other.

Soybeans.—Were tried once before in 1911 but with little success. That of course was the time when the farm was being put into shape. Varietal tests were again started this year and though the crop suffered from heavy rains and ripened very late, the results are not very discouraging. It is hoped it will do better next time.

Groundnuts.—Varietal tests (both chahi and barani—the chahis are sown a little early and get a preliminary irrigation and are then followed by a wheat like Pusa 4, which has a short growing period) have been started with this crop, which promises very encouraging results. I am very hopeful about the future of this crop in the light lands of this tract. It has already found favour with the people. The average outturn was about 738 lbs. or Rs. 72 per acre, which is not at all bad for soils, which can grow only such poor crops as moth (*phaseolus aconitifolius*), etc. Some of the varieties gave as high as 1,476 lbs. or Rs. 144 per acre.

Rabi—Wheat.—This is not only getting to be the most important crop, but the wheat work on the farm is getting more and more interesting to the public and instructive to the staff engaged on it.

The effect of the season on rabi has been discussed in the earlier part of this report. It was not favourable for the crop under report. The root system was shallow and poor—tillering was consequently meagre. The winter rains entirely failed; and these unusual factors combined to give a poor return especially from barani wheats. Withal the results were not so bad as were expected; and though this year the land did not get the usual good cultivation, yet the previous cultivation had its effects, and the outturns on the farm were almost double of the district average. The baranis on an average gave 922 lbs. and the chahis 1,863 lbs. per acre. The highest outturn in the barani was 1,512 lbs. and chahi 2,243 lbs. per acre.

The following work was done on wheat during the year under report :—

- (i) *Early and late sowings*.—The early sowings were immediately followed by heavy rains which caused very thin germination. It was thus that early sown was at a disadvantage, but it tillered better and produced good big heads. The late sown fared better and gave better results. This year's results of this trial, however, are not very reliable, but reveal some very instructive and interesting facts.
- (ii) *Comparative tests (statement 3) between*.—
 - (1) Pusa-12, 17-B, Pusa 4, Punjab 11 and $N H_4 \times P_6$ with 8-A as standard—*Chahi*.
 - (2), 8 A, Pusa 12, 17-B., with local 14 as standard—*Barani*.
- (iii) *Cultivation experiments (statement 8) —*
 - (a) Harrowing (after tillage) *versus* no harrowing.
 - (b) Sahul plough *versus* country plough.
 - (c) Raja plough *versus* country plough.
 - (d) Permanent wheat and gram plot.
 - (e) Permanent wheat plot.
- (iv) *Manurial experiments (statements 4-A, 5-A, 6 and 7) —*
 - (a) Bonemeal 5 cwt. per acre *versus* no manure.
 - (b) Super $1\frac{1}{2}$ cwt. per acre *versus* no manure.
 - (c) Phosphates and ammonium sulphate (manure applied to wheat).
 - (d) Phosphates and farm-yard manure (manure applied to previous maize-crops).
 - (e) Phosphates and green manure (manure applied half to wheat in 1916).

It is not very safe to jump at conclusions after a couple of years' work on a small scale in such tests and fix upon a certain variety from the statement of results. There are so many determining factors that only those on the spot can read them intelligently. The seasons, moreover, are so variable from year to year that it needs very extensive trials spread over a number of years to get at accurate results.

The Pusa wheats come into ears early and had more time for the development of their grain. The season was particularly favourable to them, and they have generally done better than others. Among the local types 8-A (Mr. Milne's selection) had done well. It is a bearded white type and will find more favour with the people in these tracts who prefer a bearded wheat. It yields well too. It may satisfy our requirements for both chahi and barani. It is an obvious advantage to have as few types for distribution as possible. Pusa-12 is being given out in the central districts, and is much liked by good cultivators. But as I said last year, Pusa wheats need better conditions of soil and moisture and better cultivation. They are, moreover, beardless and ripen all at once. This goes against them. People do not favour a beardless wheat, as they shed their grains when bundles are removed from one place to another, which will have always to be done in these parts where the holdings are scattered. And again people cannot manage labour to harvest them at once. They generally prefer to do it themselves gradually and a beardless dead-ripe wheat sheds its grains in the fields. N H.₄ × P₆ (Mr. Howard's new cross) is very promising and is a very high yielder, but it sheds its grains much more easily and is worse in that respect. Even with this disadvantage it may be taken up on account of its high yield and extremely strong straw. It stands wonderfully well and catches the eyes, looking a very prominent crop on a farm. Another of Mr. Milne's selections 17-B promised to do well last year, but it has not stood the test of an unfavourable year.

Cultivation experiments.—This was no year to get any results from cultivation tests. The rains in the first instance did not allow of proper cultivation and, secondly, were so late and untimely that they washed out the results that could possibly be obtained from any operation.

Deep ploughing has, as before, again given good results. I think it should now be undisputed that our barani soils do need deeper cultivation. Our country ploughs have never been able to go deeper than 3" or 4", and as the soil has been cropped for innumerable number of years, this layer of 3" or 4" is almost impoverished and needs deeper turning over. In these tests two ploughings with country plough were given against one with Sabul or Baja; other operations being equal; with the result that deep cultivation has given from 315 to 466 lbs. per acre more or the use of good inverting plough brings about Rs. 16 to Rs. 22-8 per acre more without adding to the cost of cultivation, or rather actually effecting a saving even in this latter respect.

Permanent wheat and gram plot.—Gram crop was practically lost owing to the October rains, hence the low outturn.

Permanent wheat plot.—Has given better results than last year. Evidently successive wheat cropping with good cultivation does not appear to have any great injurious effects. However, these two experiments will be continued for a good number of years to see how the continuous cropping with wheat affects the fertility of the soil.

Manurial experiments.—For details please see last year's report. I have little to add to my last year's remarks about these experiments so far. The manurial experiments in the barani was a washout. There were 6" of rain soon after they had been applied which must have washed them away to a great extent and this is the reason why the first control plot (statement 5a) has done so well. The field drains that way. I am, however, very doubtful if any artificial manures will ever pay in barani; if anything, our barani soils will be more benefited by green manuring and the addition of humus rather than by the application of any artificial manure alone. The results of the chahi experiments are so variable that it is hardly worthwhile discussing. The heavy monsoon must have washed away part of the manure applied to maize (statement 6), but that alone does not explain the variation in results. There is some other factor too. The land is uniform, the field is almost level—but it is badly drained. Improvement in this respect was desired and has already been taken in hand as this defect alone vitiates the results of so very instructive and important an experiment.

All these experiments shall be continued.

The results of Mr. Howard's crosses (see last year's report) which were kept on, will be found in statement 9. Some of them appeared to be promising and shall be tried on a large scale next year. Another wheat Cawnpore 13 was sent by Mr. Leake, Economic Botanist, United Provinces, for trial. It was grown chahi, but did not turn out as well as it looked from its appearance. The outturn was 1,501 lbs. per acre.

Poultry.—Leghorn fowls (which is the only breed kept on this farm) are becoming very popular in the district, and demand for them and their eggs is ever increasing. I am sorry a number of these were lost this summer on account of the excessive heat of the season.

Visitors.—The site for the serai has been acquired and plans and estimates for the buildings have been sent up for sanction. This will remove a very weak point in our arrangements at this station.

Over 200 visitors came to see the farm from outstations. This number does not include the district people who frequent the farm for seed, implements, advice and to select their own types of wheat and sugarcane by looking at the standing crops. The Hon'ble

Mr. Maynard, Financial Commissioner, Hon'ble Mr. Thompson, Chief Secretary to Government, Punjab, Mr. C. M. King, C.I.E., Commissioner, Lahore Division, Mr. Boyd, Additional Secretary to Government Punjab, 2nd Economic Botanist to Government, Madras, Economic Botanist to Government, Bombay, and Mr. Robertson Brown, Agricultural Officer, N.-W. F. Province, were among our distinguished visitors to the farm.

Staff.—Ch. Gurdial Singh has been the Farm Manager for the last three years and has all along done well.

Acknowledgments.—Before I close this report of the working of this station I must acknowledge the keen interest which Messrs. Estcourt and Darling have shewn in the work in progress on the farm. The former has been very interested in the wheat work and, besides, deserves our thanks for giving us the excellent site for the serai for visitors; the latter who takes a keen interest in all the activities of the department has been very energetic in spreading among his bankmen the results obtained on the farm.

FATEH-UD-DIN,

Offg. Deputy Director of Agriculture, Punjab.

Statement 1.

RAINFALL DURING THE YEAR 1916-17 AND 1917-18 IN INCHES.

Month.					1916-17.	1917-18.
July	...	...	...	...	6.52	15.14
August	...	...	...	...	4.76	14.14
September	...	...	...	...	4.59	9.05
October	...	...	...	...	.20	6.75
November	...	...	...	...	...	...
December	...	...	...	...	...	.62
January	...	...	...	...	.80	...
February	...	...	...	...	...	.08
March	...	...	...	...	.90	2.90
April	...	...	...	...	7.07	2.73
May	...	...	...	...	1.58	...
June	...	...	...	...	4.94	1.96
Total					30.86	53.37

Statement 2.

TESTS OF SUGARCANE VARIETIES,

No. of field.	Name of variety.	Area harvested in square yards.	Weight of canes in lbs.	Weight of juice in lbs.	Weight of shakar in lbs.	Weight of canes per acre in lbs.	Weight of juice per acre in lbs.	Weight of gur per acre in lbs.	Weight of shakar per acre in lbs.	Percentage of juice to canes.	Percentage of gur to juice.	Percentage of shakar to canes.	Percentage of gur to canes.	REMARKS.
5	Kakara	1,591	11,363	5,760	954	34,568	17,523	2,902	...	50.69	16.56	...	8.39	Discarded.
	Nargori	2,025	14,578	7,117	1,298	34,833	17,011	3,102	...	48.83	19.24	...	8.90	Ditto.
	Khari	2,073	11,608	5,945	1,041	27,102	13,880	2,431	...	51.21	17.51	...	8.97	Ditto.
	Dhaura of Azamgarh	362	3,030	1,482	117	40,512	19,815	1,564	1,457	48.91	7.89	7.35	3.59	
	Lalri	3,275	24,108	13,507	2,246	35,628	18,484	3,319	...	51.88	17.96	...	9.32	Discarded.
	Suretha	1,606	9,164	4,875	901	27,613	14,692	2,715	...	53.19	18.48	...	9.83	
	Yuba	500	4,186	2,078	358	40,520	20,115	3,465	...	49.64	17.23	...	8.55	
	Behar	250	4,205	2,263	403	31,409	43,812	7,802	...	53.82	17.80	...	9.58	
	Sonabelli	206	1,300	658	109	30,544	15,480	2,561	...	50.61	16.57	...	8.38	
	Mango	1,856 } + 2,686 } 1,380 }	15,697	8,434	732	28,285	15,198	1,319	1,127	53.73	8.66	7.43	3.99	Discarded.
10 B	Reora of Benares	1,931 } + 2,756 } 825 }	19,173	9,482	1,105	33,671	16,652	1,941	787	49.45	11.65	4.72	5.76	Ditto.
	Burli	2,009 } + 2,666 } 657 }	12,159 } + 16,135 } 8,976 }	7,507	950	29,292	13,629	1,725	481	46.53	12.65	3.53	5.88	
	Dhaura of Azamgarh	2,254 } + 2,666 } 412 }	13,593 } + 16,423 } 2,630 }	7,981	1,161	29,815	14,439	2,108	386	48.59	14.55	2.32	7.06	
	J 33	186	852	4.3	70	22,170	12,308	1,822	...	55.52	14.79	...	8.21	
10 A	J 15	186	1,619	908	150	42,129	28,497	3,903	...	55.77	16.61	...	9.26	

Statement 3.

COMPARATIVE TESTS OF WHEATS.

No. of field.	Name of variety.	Area reaped in square yards.	ACTUAL OUTTURN IN LBS.		OUTTURN PER ACRE IN LBS.		REMARKS.	
			Grain.	Straw.	Grain.	Straw.		
BARANI.								
12	Punjab 14	709	111	301	758	2,055	Raja plough = 3. Spring tined harrow = 14. Country plough = 2. Sohaga = 6. Wheat harrowing = 2. Date of sowing—10th November 1917. Date of harvesting—28th April 1918.	
	Pusa 12	673	113	249	813	1,791		
	Punjab 14	673	102	284	734	2,042		
	17 B	691	85	233	595	1,632		
	Punjab 14	673	103	261	741	1,877		
	Punjab 14	691	157	359	1,100	2,515		
	8-A	673	183	485	1,316	3,438		
13	Punjab 14	673	214	542	1,539	3,898	Raja plough = 3. Spring tined harrow = 14. Country plough = 2. Sohaga = 6. Wheat harrowing = 2. Date of sowing—10th November 1917. Date of harvesting—22nd and 28th April 1917. Average outturn per acre— Lbs. Punjab 14 ... 1,038 Pusa 12 ... 1,012 8 A ... 1,105½ 17 B ... 827	
	Punjab 14	675	146	366	1,047	2,624		
	Pusa 12	686	153	333	1,079	2,349		
	Punjab 14	675	150	426	1,076	3,055		
	17 B	675	129	345	925	2,474		
	Punjab 14	686	137	401	987	2,829		
	Punjab 14	686	159	463	1,122	3,267		
	8 A	675	159	457	1,140	3,277		
	Punjab 14	686	150	436	1,058	3,076		
	Pusa 12	686	162	352	1,143	2,433		
	Punjab 14	686	146	404	1,030	2,550		
	17 B	675	134	366	961	2,624		
	Punjab 14	686	154	428	1,087	3,020		
	Punjab 14	665	144	386	1,048	2,809		
	8 A	686	122	463	861	3,302		
Punjab 14	665	168	444	1,223	3,232			
CHANI.								
3	8 A	860	288	1,184	1,621	6,663	Raja plough = 3. Spring tined harrow = 6. Country plough = 4. Sohaga = 7. Wheat harrowing = 2. Date of sowing—10th November 1917. Date of harvesting—16th, 21st, 22nd and 29th April 1918.	
	Pusa 12	860	311	839	1,750	4,722		
	8 A	860	289	991	1,626	5,577		
	8 A	860	376	774	2,116	4,356		
	17 B	860	207	699	1,165	3,934		
	8 A	860	305	795	1,716	4,474		
	Pusa 4	860	289	806	1,626	4,536		
	8 A	860	326	804	1,835	4,525		
	8 A	860	340	912	1,913	5,133		
	Punjab 11	860	220	750	1,238	4,221		
	8 A	860	289	909	1,626	5,116		
	NH ₄ × P ₀	860	353	1,063	2,015	5,011		
	8 A	860	314	868	1,767	4,998		
	Pusa 12	860	320	828	1,801	4,659		
	8 A	860	291	987	1,638	5,555		
	8 A	860	284	974	1,598	5,482		
	17 B	860	253	987	1,424	5,555		
	8 A	860	249	925	1,401	5,206		
	Pusa 4	860	368	984	2,071	5,538		
	8 A	860	282	958	1,587	5,392		
	8 A	857	280	936	1,581	5,286		
	Punjab 11	857	250	730	1,412	4,123		
	8 A	423	180	536	2,060	6,133		
	NH ₄ × P ₀	423	196	498	2,243	5,698		
8 A	857	300	936	1,694	5,286			
Pusa 12	857	314	871	1,773	4,919			
4	8 A	857	300	874	1,694	4,936	Raja plough = 3. Spring tined harrow = 5. Country plough = 4. Sohaga = 9. Wheat harrowing = 2. Date of sowing—10th November 1917. Date of harvesting—16th, 21st, 22nd and 29th April 1918.	
	8 A	857	262	1,022	1,480	5,772		
	17 B	857	247	821	1,395	4,637		
	8 A	857	311	781	1,756	4,411		
	Pusa 4	857	341	999	1,926	5,641		
	8 A	857	293	1,005	1,655	5,676		
	8 A	857	323	1,050	1,852	5,918		
	Punjab 11	857	236	854	1,333	4,823		
	8 A	857	311	989	1,756	5,585		
	NH ₄ × P ₀	857	298	1,234	1,683	6,969		
	8 A	857	336	925	1,892	5,224		
	Average for outturn per acre—							Lbs.
	Pusa 12							... 1,774½
	8 A							... 1,721
	17 B							... 1,328
	Punjab 11							... 1,327½
Pusa 4						... 1,874½		
NH ₄ × P ₀						... 1,960		

Statement 4.

SHOWING THE RESULTS OF SUPER AND BONEMEAL IN CONJUNCTION WITH FARMYARD MANURE ON MAIZE.

No of field and plot	Variety.	Area harvested in square yards.	Treatment.	Actual outturn in lbs.	Outturn per acre in lbs.	Increase or decrease per acre in lbs.	Price of increase or decrease at Rs. 2-15-0 per maund.	Price of manure per acre.	Profit and loss per acre.	REMARKS.
9 B 1	Sargodha Maize	671	Farmyard manure=40 lbs. N per acre	111	801	...	...	Rs. A. P.	Rs. A. P.	...
9 B 2		671	Farmyard + bonemeal=30 lbs. P, O, per acre	90	649	-152	-5 7 9	5 8 3	-11 0 9	...
9 B 3		671	Farmyard + super=30 lbs. P, O, per acre	117	844	+43	+1 8 9	6 1 3	-4 8 6	...
9 B 4		671	Farmyard manure=40 lbs. N per acre	119	858	...	...	...	...	...
9 B 5		671	Farmyard + bonemeal=30 lbs. P, O, per acre	127	916	+58	+2 1 6	5 8 3	-3 6 9	...
9 B 6		671	Farmyard + super=30 lbs. P, O, per acre	102	736	-122	-4 6 6	6 1 3	-10 7 9	...

Raja plough=1.
Spring tined harrow=2.
Country plough=2.
Sohaga=1.
Date of sowing=17th July 1917.
Date of harvesting=17th October 1917.

Statement 4 A.

SHOWING THE RESULTS OF RESIDUAL EFFECT OF SUPER AND BONEMEAL IN CONJUNCTION WITH FARMYARD MANURE ON WHEAT.

(Manure applied to maize in kharif 1917.)

1	2	3	4	5		6		7		8	9	10	11	12	13
No. of field and plot.	Name of variety.	Area reaped, in square yards.	Previous treatment.	ACTUAL OUTTURN IN LBS.		OUTTURN PER ACRE IN LBS.		INCREASE OR DECREASE PER ACRE IN LBS.		Price of grain at Rs. 4-8-0 per maund of increase or decrease.	Price of straw at Re. 0-12-0 per maund of increase or decrease.	Total of columns 8 and 9.	Previous profit or loss on maize per acre.	Net profit and loss per acre.	REMARKS.
				Grain.	Straw.	Grain.	Straw.	Grain.	Straw.						
9 B 1		671	Farmyard manure = 40 lbs. N per acre	246	504	1,774	3,685	...	...	...	...	...	...	...	
9 B 2		671	Farmyard + bonemeal = 30 lbs. P ₂ O ₅ per acre.	235	533	1,695	3,845	-79	+210	-4 5 3	+1 14 9	-2 6 6	-11 0 0	-13 6 6	
9 B 3		671	Farmyard + super = 30 lbs. P ₂ O ₅ per acre.	218	608	1,572	4,386	-202	+751	-11 0 9	+6 13 0	-4 4 3	-4 8 6	-8 12 9	Raja plough Spring tined harrow = 3 Sohaga = 4
9 B 4		671	Farmyard manure = 40 lbs. N per acre	210	520	1,515	3,754	...	...	...	...	...	...	...	Wheat harrowing = 2 Date of sowing - 9th November 1917.
9 B 5		671	Farmyard + bonemeal = 30 lbs. P ₂ O ₅ per acre.	236	556	1,704	4,010	+187	+259	+10 8 9	+2 5 9	+12 9 -6	-3 6 9	+9 2 9	Date of harvesting - 30th April 1918.
9 B 6		671	Farmyard + super = 30 lbs. P ₂ O ₅ per acre.	257	587	1,854	4,234	+339	+433	+18 8 9	+4 6 6	+22 15 3	-10 7 9	+12 7 6	
9 B 1-4		671	Farm yard manure	228	512	1,644-5	3,698-1	...	...	...	...	...	...	...	
9 B 2-5		671	Farmyard manure + bonemeal	235-5	544	1,698-5	3,927-5	+54	+234-5	+2 15 3	+2 2 3	+5 1 6	-7 3 3	-2 1 9	
9 B 3-6		671	Farmyard manure + super	237-5	597-5	1,713	4,810	+68-5	+617	+3 12 0	+5 9 9	+9 5 3	-7 8 3	+1 13 0	

Statement 5.

SHOWING THE RESULTS OF RESIDUAL EFFECT OF SUPER AND BONEMEAL IN CONJUNCTION WITH GREEN MANURING (SAN HEMP) ON LOCAL MAIZE.

(Manure applied half to green manure and half to wheat in 1916.)

1	2	3	4	5	6	7	8	9	10
No. of field and plot.	Area harvested in square yards.	Previous treatment.	Actual outturn in lbs.	Outturn per acre in lbs.	Increase or decrease per acre in lbs.	Price of grain at Rs. 2-15-6 per maund of increase or decrease.	Previous profit or loss per acre.	Profit or loss per acre.	REMARKS.
8 B 1	750	Unmanured ...	262	1,691	...	...	Rs. A. P.	Rs. A. P.	
8 B 2	750	Green manure ...	287	1,852	...	...	...	...	
8 B 3	750	Green manure + super = 20-76 lbs. P ₂ O ₅ per acre.	273	1,762	- 90	- 3 4 0	- 0 9 11	- 3 13 11	Raja plough = 1. Spring tined harrow = 5.
8 B 4	750	Green manure + bonemeal = 20-76 lbs. P ₂ O ₅ per acre.	284	1,510	- 342	- 12 5 3	- 2 10 6	- 14 15 9	Sohaga = 4. Date of sowing—28th June 1917.
8 B 5	750	Green manure ...	236	1,523	...	...	...	...	Wheat harrowing = 2. Date of harvesting—18th September 1917.
8 B 6	750	Green manure + super = 20-76 lbs. P ₂ O ₅ per acre.	258	1,665	+ 142	+ 5 4 3	+ 0 5 10	+ 5 10 1	
8 B 7	750	Green manure + bonemeal = 20-76 lbs. P ₂ O ₅ per acre.	287	1,832	+ 329	+ 11 14 0	- 3 5 2	+ 8 8 10	
8 B 2-5	750	Green manure ...	261-5	1,687-5	...	...	...	...	
8 B 3-6	750	Green manure + super ...	235-5	1,713-5	+ 26	+ 1 0 0	- 0 2 0	+ 0 14 0	
8 B 4-7	750	Green manure + bonemeal ...	250-5	1,651	- 6-5	- 0 3 8	- 2 15 10	- 3 3 6	
					AVERAGE.				

Statement 5-A.

SHOWING THE RESULTS OF THE RESIDUAL EFFECT OF SUPER AND BONEMEAL IN CONJUNCTION WITH GREEN MANURE (SAR HEMP) ON WHEAT.

(Manure applied half to green manure and half to wheat in 1916.)

1	2	3	4	5		6		7		8	9	10	11	12	13
No. of field and plot.	Variety.	Area harvested in square yards.	Previous treatment.	ACTUAL OUTPUT IN LBS.		OUTPUT PER ACRE IN LBS.		INCREASE OR DECREASE PER ACRE IN LBS.		Price of grain at Rs. 4-0-0 per maund of increase or decrease.	Price of straw at Re. 9-12-0 per maund of increase or decrease.	Total of columns 8 and 9	Previous profit or loss per acre.	Profit or loss per acre.	REMARKS.
				Grain.	Straw.	Grain.	Straw.	Grain.	Straw.						
8-B	8 A	375	Unmanured	149	417	1,922	5,283	...	...	...	...	...	...	...	Raja plough = 1.
1	Pusa 12	375	Ditto	147	373	1,897	2,523	...	...	...	...	...	...	...	Spring tined harrow = 6.
8-B	8 A	375	Green manuring	161	423	2,078	5,460	...	...	...	...	...	...	...	Country plough = 2.
2	Pusa 12	375	Ditto	170	424	2,194	5,472	...	...	...	...	...	...	...	Sohaga = 5.
8-B	8 A	375	Green manuring + super = 20-76 lbs. P. O. per acre.	153	401	2,104	5,176	+26	-284	+1 6 9	-2 9 0	-1 2 9	-2 13 11	-5 0 8	Wheat harrowing = 2.
3	Pusa 12	375	Ditto	172	374	2,220	4,827	+26	-645	+1 6 9	-5 14 3	-4 7 6	-3 13 11	-8 5 5	Date of sowing 9th November 1917.
8-B	8 A	375	Green manuring + bonemeal = 20-76 lbs. P. O. per acre.	149	325	1,923	4,195	-155	-1,265	-8 7 6	-11 3 6	-20 0 0	-14 15 9	-34 15 9	Date of harvesting 16th and 30th April 1918.
4	Pusa 12	375	Ditto	135	199	1,742	3,568	-452	-2,904	-24 11 6	-26 7 6	-51 3 0	-14 15 9	-66 2 9	
8-B	8 A	375	Green manuring	143	366	1,910	4,724	...	...	...	...	...	...	...	
5	Pusa 12	375	Ditto	136	272	1,755	3,511	...	...	...	...	...	...	...	
8-B	8 A	375	Green manuring + super = 20-76 lbs. P. O. per acre.	141	337	1,820	4,350	-90	-374	-4 14 9	-3 6 6	-8 5 3	+5 10 1	-2 11 2	
6	Pusa 12	375	Ditto	143	267	1,846	3,446	+91	-65	+4 15 6	-0 9 6	+4 6 0	+5 10 1	+10 4 1	
8-B	8 A	375	Green manuring + bonemeal = 20-76 lbs. P. O. per acre.	156	354	2,013	4,569	+103	-155	+5 10 0	-1 6 6	+4 3 6	+8 8 10	+12 12 4	
7	Pusa 12	375	Ditto	150	342	1,936	4,414	+131	+903	+9 14 6	+8 3 9	+18 2 3	+8 8 10	+26 11 1	

AVERAGE.

8-B	8 A	375	Green manure	153-75	371-25	1,981-35	4,791-75	...	...	...	...	...	...	...	
2-6	Pusa 12	375	Green manure + bonemeal	147-5	305	1,903-5	3,936-5	-81	-855	-4 6 7 1/2	-7 12 9	-12 4 0	-3 3 5	-15 7 5	
8-B	8 A	375	Green manure + super	154-75	344-75	1,927-5	4,849-75	+134	-342	+0 11 6	-3 1 1 1/2	-2 6 4	+0 14 1	-1 8 3	

Statement 6.

EFFECT OF BONEMEAL AND SUPER ON WHEAT YIELDS IN BARANI AREA.

1	2	3	4		5	6	7		8	9	10	11	12	13	
No. of field and plot.	Name of variety.	Area harvested in square yards.	ACTUAL OUTPUT IN LBS.		OUTPUT PER ACRE IN LBS.		Manure and rate per acre.	INCREASE OR DECREASE PER ACRE IN LBS.		Price of grain at Rs. 4-8-0 per maund of increase or decrease.	Price of straw at Rs. 0-12-0 per maund of increase or decrease.	Total of columns 8 and 9.	Price of manure per acre.	Profit or loss per acre.	REMARKS.
			Grain.	Straw.	Grain.	Straw.		Grain.	Straw.						
17 16, 17, 19	Punjab 14 ...	2,418	405	905	811	1,811	Bonemeal 5 cwt. per acre.	+48	-77	+2 10 0	-0 11 3	+1 14 9	30 0 0	-28 1 3	
"	17 B ...	2,418	346	852	693	1,705	Ditto	+127	+178	× 6 15 0	+1 10 0	8 9 0	30 0 0	-21 7 0	
17 16, 18, 20	Punjab 14 ...	2,418	381	943	763	1,868	No manure	...	...	...	...	...	...	...	Rajah plough = 3. Spring tined harrow = 13 Country plough = 2 Sahga = 4 Whea. harrowing = 5 Date of sowing—21st and 22nd Oct. Ber 1917. Date of harvesting—19th and 23rd April 1918.
"	17 B ...	2,418	283	753	566	1,527	Ditto	...	...	...	...	...	...	...	
17 21, 23	Punjab 14 ...	806	117	311	703	1,868	Super 1½ cwt. per acre.	+127	+787	+6 15 0	+7 3 2	+14 2 2	9 12 3	+4 5 11	
"	17 B ...	806	121	306	727	1,838	Ditto	+30	+541	+1 10 3	+4 15 0	+6 9 3	9 12 3	-3 3 0	
17 22, 24	Punjab 14 ...	806	96	180	576	1,081	No manure	...	...	...	...	...	...	...	
"	17 B ...	806	116	216	697	1,297	Ditto	...	...	...	...	...	...	...	

Statement 7.

SHOWING THE RESULTS OF BONEMEAL AND SUPER IN CONJUNCTION WITH AMMONIUM SULPHATE ON WHEAT IN BARANI AREA.

1	2	3	4	5		6		7		8	9	10	11	12	13
No. of field and plot.	Name of variety.	Area harvested in square yards.	Treatment.	ACTUAL OUTTURN IN LBS.		OFTURN PER ACRE IN LBS.		INCREASE OR DECREASE PER ACRE IN LBS.		Price of grain of increase or decrease at Rs. 4-8-0 per maund.	Price of straw of increase or decrease at Rs. 0-12-0 per maund.	Total of columns 8 and 9.	Price of manure per acre.	Profit or loss per acre.	REMARKS.
				Grain.	Straw.	Grain.	Straw.	Grain.	Straw.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	
21	...	752	Control	133	211	856	1,358	...	...	...	...	...	...	...	Raja plough = 3.
1	...	752	Ammonium sulphate = 20 lbs. N. per acre.	108	189	663	1,216	193	142	10 8 9	1 4 9	11 13 6	16 10 6	28 8 0	Spring tined barrow = 10.
2	...	752	Ammonium sulphate + super = 15 lbs. P ₂ O ₅ per acre.	108	210	695	1,352	161	6	8 12 9	0 1 0	8 13 9	20 10 6	29 3 3	Country plough = 3.
3	...	752	Ammonium sulphate + bonemeal = 15 lbs. P ₂ O ₅ per acre.	104	174	669	1,120	187	238	10 3 9	2 2 9	12 6 6	20 5 3	32 11 9	Solaga = 4.
4	...	752	Control	90	170	579	1,094	...	...	...	...	...	...	...	Wheat harrowing = 4.
5	...	752	Ammonium sulphate = 20 lbs. N per acre.	89	195	573	1,255	6	161	0 5 3	1 7 6	1 2 3	16 10 6	15 8 3	Date of sowing — 23rd October 1917.
6	...	752	Ammonium sulphate + super = 15 lbs. P ₂ O ₅ per acre.	59	225	380	1,448	199	354	10 14 9	3 2 6	7 12 3	20 10 6	28 6 9	Date of harvesting — 10th April 1918.
7	...	752	Ammonium sulphate + bonemeal = 15 lbs. P ₂ O ₅ per acre.	83	201	584	1,294	45	200	2 7 6	1 13 3	0 10 3	20 5 3	20 15 6	
8	...	752	Control	90	224	579	1,442	...	...	...	...	...	...	...	
9	...	752	Ammonium sulphate = 20 lbs. N per acre.	106	210	682	1,352	103	90	5 10 0	0 13 0	4 13 0	16 10 6	11 13 6	
10	...	752	Ammonium sulphate + super = 15 lbs. P ₂ O ₅ per acre.	91	211	586	1,358	7	84	0 6 3	0 12 3	0 6 0	20 10 6	21 0 6	
11	...	752	Ammonium sulphate + bonemeal = 15 lbs. P ₂ O ₅ per acre.	131	267	843	1,718	264	276	14 6 9	2 8 3	16 15 0	20 5 3	3 6 3	
12	...														

Statement 8.

EFFECT OF CULTIVATION ON WHEAT YIELD.

No. of field.	Area har- vested in square yards.	Name of variety.	Cultivation.	ACTUAL OUT- TURN IN LBS.		OUTTURN PER ACRE IN LB. s.		REMARKS.
				Grain.	Straw.	Grain.	Straw.	
15	5,884	Punjab 14	Raja plough	1,530	3,643	1,283	3,001	Raja plough = 3. Spring tined harrow = 14. Country plough = 2. Sohaga = 6. Wheat harrowing = 2. Date of sowing—10th No- vember 1917. Date of harvesting—20th and 26th April 1918.
15	5,884	Pusa 12	Raja plough	1,493	2,869	1,223	2,360	
15	5,906	Pusa 12	Country plough	1,114	2,536	913	2,078	
15	5,906	Punjab 14	Country plough	997	3,223	817	2,641	
12a	1,289	Pusa 12	Sabul plough	338	778	1,269	2,921	Ploughings = 3. Spring tined harrow = 14. Country plough = 2. Sohaga = 6. Wheat harrowing = 2. Date of sowing—10th No- vember 1917. Date of harvesting—22nd and 28th April 1918.
12a	1,289	Punjab 14	Ditto	290	808	1,089	3,084	
12a	1,289	Punjab 14	Country plough	275	821	1,033	3,083	
12a	1,289	Pusa 12	Ditto	300	772	1,127	2,899	
17	2,418	Punjab 14	Sabul plough	423	1,161	859	2,204	Ploughings = 3. Spring tined harrow = 13. Country plough = 2. Sohaga = 4. Wheat harrowing = 5. Date of sowing—21st and 22nd October 1917. Date of harvesting—19th, 23rd, 25th and 26th April 1918. Ploughing=Raja, Sabul or 2 Country plough.
17	2,418	17 B	Ditto	331	865	663	1,731	
17	2,418	Punjab 14	Country plough	423	1,073	859	2,148	
17	2,418	17 B	Ditto	394	708	588	1,417	
17	2,418	Punjab 14	Unharrowed	364	894	729	1,709	Raja plough = 3. Spring tined harrow = 13. Country plough = 2. Sohaga = 4. Wheat harrowing = 5. Date of sowing—21st and 22nd October 1917. Date of harvesting—19th, 23rd, 25th and 26th April 1918.
17	2,418	17 B	Ditto	347	823	695	1,647	
17	2,418	Punjab 14	Harrowed	341	925	683	1,852	
17	2,418	17 B	Ditto	351	885	703	1,771	
17	3,224	Pusa 12	Permanent wheat plot.	582	1,278	874	1,918	Raja plough = 2. Spring tined harrow = 8. Country plough = 2. Sohaga = 2. Wheat harrowing = 2. Date of sowing—21st Octo- ber 1917. Date of harvesting—11th April 1918.
12	2,238	Pusa 12 and gram.	Permanent wheat and gram plot.	262	620	392	927	Raja plough = 3. Spring tined harrow = 10. Country plough = 2. Sohaga = 5. Wheat harrowing = 2. Date of sowing—21st Octo- ber 1917. Date of harvesting—11th April 1918.

Statement 9.

SHOWING THE RESULTS OF MR. HOWARD'S CROSSES, AND OF ECONOMIC BOTANIST,
UNITED PROVINCES.

No. of field.	Name of variety.	Area harvested in square yards.	ACTUAL OUTTURN IN LBS.		OUTTURN PER ACRE IN LBS.		REMARKS.
			Grain.	Straw.	Grain.	Straw.	
6 a	N. H ₁₀ × P _a ...	323	97	659	1,453	9,875	Raja plough = 4. Spring tined harrow = 6. Country plough = 5. Sohaga = 9. Wheat harrowing = 1. Date of sowing—16th November 1917. Date of harvesting—23rd and 24th April 1918.
	N. H ₁₀₅ × P _a ...	341	77	745	1,093	10,574	
	N. H ₂₀ × P _a ...	664	313	1,049	2,282	7,646	
	N. H ₃₀ × P _a ...	897	429	1,197	2,315	6,459	
	N. H ₄₀ × P _a ...	1,364	655	2,073	2,324	7,356	
	N. H ₅₀ × P _a ...	963	629	1,577	3,151	7,901	
	N. H ₆₀ × P _a ...	388	146	656	1,321	3,153	
	N. H ₁₂₀ × P _a ...	388	167	519	2,083	6,474	
	N. H ₁₁₀ × P _a ...	388	184	520	2,295	6,487	
	N. H ₁₀₀ × P _a ...	388	185	539	2,308	6,724	
20	N. H ₁₀₀ × P _a ...	388	149	475	1,259	5,925	Raja plough = 3. Spring tined harrow = 13. Country plough = 2. Sohaga = 4. Wheat harrowing = 3. Date of sowing—23rd October 1917. Date of harvesting—16th and 23rd April 1918.
	C ₁₂ ...	4,326	1,342	3,302	1,501	3,694	
	N. H ₁₀ × P _a ...	380	152	370	1,936	4,713	
	N. H ₁₂₀ × P _a ...	433	131	349	1,464	3,901	
	N. H ₂₀ × P _a ...	500	112	254	1,084	2,459	
	N. H ₁₁₀ × P _a ...	597	116	278	940	2,254	
	N. H ₁₀ × P _a ...	315	60	133	922	2,389	
	N. H ₁₀ × P _a ...	288	41	131	639	2,202	

APPENDIX VII (A).

Report of the Officiating Deputy Director of Agriculture on Sargodha Farm.

Introductory.—In the beginning of the Lower Jhelum Colony some 21 squares were reserved near Sargodha town for a seed farm to grow, multiply and supply pure and improved seeds of wheat and cotton to that colony. The farm was started in 1904 and was run by the Colony Tahsildar under the general control of the Colonization Officer. The Tahsildar had a Munshi on Rs. 16 per mensem to help him, who lived on the farm. The land was farmed by tenants.

In 1911, 15 of these squares were given to Raja Sir Harnam Singh as a grant by Government, leaving behind 5½ squares—½ square having gone under "abadi." The farm did not serve any useful purpose till 1913 when it was taken over by the Department, and till 1916-17 it continued only as a seed farm supplying wheat and cotton seeds to that locality, when a part of the farm was separated and laid out for experimental work for local varietal tests of the types of wheat and cotton. This, therefore, is the first year of any experimental work on this farm.

It is very well situated and the soil is average and representative of the tract.

There are only 45 acres under our direct and experimental cultivation, and nearly 112 acres with the tenants, who have to follow our methods and instructions, use our implements, and grow our seeds only. The laying out of the experimental area is complete but still a good deal of levelling is required if any reliable results are to be expected from the tests to be conducted thereon. The results of varietal tests of both cotton and wheat, therefore, for the year under report are neither quite conclusive nor very reliable.

Cottons.—There were 5 varieties under test—two American (4 F and 280 F—both M. Milne's selections) and 3 desi—22 Mollisoni, 40 Rosea and Khanna. The seed of 22 Mollisoni and 40 Rosea was obtained from Economic Botanist, as these too are his selections, and that of Khanna was obtained from a factory at Khanna. The inclusion of the Khanna (which is not a pure type but a mixture) was due to the local factory's preference for it owing to its high lint percentage. The test was duplicated. The results will be found in statement 1-4 F among the Americans and Khanna among the desis have done well both as regards outturn and profit per acre; and comparing them all together Khanna has scored. Both its high outturn per acre and its quite high lint percentage has helped to bring in higher returns in its case. Desis do better than Americans as far as lint percentage is concerned, and from that point both Mollisoni and Rosea have done very well, the latter topping the list with a lint percentage of 38 (the actual weight of lint from one maund of kapas was 15 seers, 3 chataks, 1 tola and 8 mashas).

Root-rot was pretty bad in all cottons, Khanna and Mollisoni suffering most. The rains were heavy and incessant last summer, and cotton suffered to some extent, hence not very high yields.

Wheat.—The types under test were—Punjab 11—already distributed for seed,

8 A	} Economic Botanist's selection, and
B	
17 B	
20 C	
9 C	

Pusa 12.

The test was repeated four times, Punjab 11 being used as standard. As this area under these tests has just been laid out, it was here and there unequal in character and a statement (6) is attached showing poor, average and good bits to enable an outsider to read the results intelligently. The season was bad, and taking this into consideration all the types have done well; the average of the district being 9½ maunds (779 lbs.) per acre, but their cultivation too has played its part in obtaining these results.

8 A, here too, as in other places on the canals has done well and promises to be our future wheat for distribution.

Water saving experiment (Statements 4 and 5).—Besides the wheat varietal tests, water saving experiments are also being conducted in rabi to find out the water requirements of wheat or to put it better, to prove that our wheat crops in the colonies do not require so much water as they are given and that this results not only in wastage of water, but reduces the outturn as well. The experiment was started on the recommendations of Mr. Howard. The operations, to be carried out, as summed up by Mr. Howard himself are:—

- (a) The stubble should be broken up as early as possible to allow of complete absorption of monsoon rainfall. This must be conserved by surface cultivation with the spring-tine cultivator after each large fall.

- (b) After the preliminary irrigation, applied about November 10th, the surface must be cultivated by the spring-tine cultivator as soon as the ground is just dry enough, followed by the beam. The land should be ploughed, the wheat sown in the furrows and covered in as soon as possible.
- (c) All surface crusts formed by rain, dew and irrigation water should be broken at once with the lever harrow, the first harrowing being done as soon as the wheat is up. When the lever harrow can no longer be used, the Brantford weeder can be employed to break crusts.
- (d) The second irrigation should be given to half the plot about the end of January.
- (e) The variety sown should be Pusa 12.
- (f) The plot should be laid out in long oblong *kharis* with the proper slope ($1\frac{1}{2}$ to 2" per 100'). In stopping water in the distributary, the canvas dam should be used.

It is a very interesting and instructive experiment and the results (statement 4) are very encouraging. "No water" after sowing gave 1,189 lbs. per acre as against 779 lbs., the district average of the canal irrigated wheat. The low outturn of *bhusa* in the case of no water crop is also worth notice, naturally too much water tends to vegetative growth. There were occasional slight showers in March amounting to 3.20". These helped the "no water" plot a good deal and in fact equalised both the "no water" and one water tests, hence it is that the test shows no difference between the different treatments.

Another test (statement 5), one water after sowing against two was, also started on the same lines as indicated by Mr. Howard above, to see how few irrigations would give the maximum outturn and how much would be added by an extra irrigation. The soil where the test was carried out, is very light, hence there rather low outturns.

These experiments shall next year be tried with some interested zemindars, out in the district too, to corroborate the results obtained on the farm. They show how far the complaint about shortage of water is justified. They further prove that aeration of the soil is as important as irrigation and it is assential, if high yields are to be obtained, that the soil surface must be kept loose for the free access of air, as also that this enormous wastage of water could be easily avoided by proper and timely cultivation of the soil, if the colonist did not make irrigation take the place of cultivation. Of course the method of cultivation given above would ensure a vast saving in canal water—but what is to be done with it? That question perhaps is out of place here, but there should be no doubt that this judicious use of irrigation water should at least help to keep off water-logging conditions.

Another wheat called C 13 (Cawnpore 13) was sent by Mr. Leake to be given a trial. It has not done particularly well, the outturn being 1523½ lbs. (or 18 maunds 23 seers and 4 chataks) per acre.

Ratoon crop of wheat.—I wonder if "Ratoon" signifies properly what I mean, some 6 kanals of wheat was sold out as green fodder and the buyer had removed a cutting by the end of January. The plant again sprouted as they generally do and were allowed to grow. But the buyer never returned to take a second cutting (early cut wheat does give a second cutting, meagre though it may be) and the crop was consequently allowed to mature the grain. This bit (6 kanals) gave 279 lbs. or 337 lbs. of grain per acre. It had been manured in the previous year for cotton.

Seed distribution work.—Seed selection work with wheat Punjab 11 (which is at present distributed in the colony for want of any thing better) and cotton, 4 F is done on the farm and the produce of the farm is sold out for further multiplication and distributed as seed in the colony. In the first year (1914) 15 maunds of cotton and 500 maunds of wheat seed were given out, but the demand steadily rose, and during the year under report the farm was responsible for 45,000 acres of wheat from its seed and 15,000 acres of cotton, while in the last spring 410,000 lbs. of cotton seed, sufficient to grow 50,000 acres have been given under its auspices for 1917-18 crop.

Tenants.—Tenants have 112 acres under them. Their presence on the farm is very useful. The surrounding zamindars when they find some one from amongst their own brethren working modern implements, etc., quite successfully, resolve to give them a trial themselves rather than looking askance at them. This latter would certainly have been the case if the whole area were under our direct cultivation. I know of some people in that colony who began to use our implements, simply because they were known to our tenants. They came to the farm to see them, saw them using these implements, handled these implements themselves, were told they were more efficient and quite easy to work, asked for their loans for a few days, and ultimately after that short trial came back, not to return the implements but to pay for them. They are further useful in spreading out their knowledge about the working of our implements, and usefulness of our seeds and our methods of cultivation. Being trained on the farm they are often in demand and are offered very favourable terms by those who wish to introduce these implements among their tenants and on their farms.

Visitors.—The visitors' book was opened on 17th August 1917, from that date up to the end of June, over 300 visitors came to see the farm. His Honour accompanied by the Commissioner Sir F. P. Young and Mr. Gibson, Deputy Commissioner, paid a visit to the farm in early March. Other distinguished visitors were the Hon'ble Mr. Maynard, Financial Commissioner, Mr. Sangster, Superintending Engineer, Lower Jhelum Canal, Mr. Mackenna, Agricultural Adviser to Government of India and member of the Indian Cotton Committee, Majors Hagger and Mayne, Superintendents, Army Remount Depot at Sargodha.

Income and expenditure.—The total receipts from the sale of the farm produce were Rs. 6,759 and the expenditure during the year amounted to Rs. 2,000.

Staff.—Q. Samiullah has been in charge of this farm as well as the district work under my control. He has done excellent work in both these capacities as Farm Manager and District Assistant.

FATEH-UD-DIN,

The 10th August 1918.

Offg. Deputy Director of Agriculture, Gurdaspur.

Statement No. 1.

STATEMENT SHOWING THE AVERAGE OUTTURN OF AND MARKET VALUE OF DIFFERENT VARIETIES OF DESI AND AMERICAN COTTONS TRIED AT THE SARGODHA SEED FARM IN KHARIF 1917 ON THE AREA HARVESTED.

Serial No.	Name of variety.			Average produce in lbs. per acre.	Price per acre.			REMARKS.
					Rs.	A.	P.	
1	4 F Am.	...	...	794.945	205	12	6	4th.
2	280 F.	...	...	752.805	175	9	3½	5th.
3	22 Mollisoni	...	...	942.106	211	5	10½	2nd.
4	40 Rosea	...	...	799.121	179	11	3	3rd.
5	Khanna	...	...	986.803	216	11	7	1st.

Statement No. 2.

STATEMENT SHOWING THE OUTTURN OF DESI AND AMERICAN COTTON VARIETIES TESTED IN KHARIF 1917-18.

(Standard 4 F. American cotton.)

No. of plot.	Name of variety.	Area sown in square yards.	Area destroyed by root rot in square yards.	Area harvested in square yards.	Actual outturn in lbs.	Outturn per acre on the area sown in lbs.	Outturn per acre on the area harvested in lbs.	Lint from a maund of kapas (kan).	Price per maund according to lint percentage and kapas as well.*	Actual price.	Price per acre on the area sown.	Price per acre on the area harvested.	Date of sowing.	Date of picking.	REMARKS.
DF	22 Mollisoni	3,320	...	3,320	195.6	855.6	855.6	Srs. Tolas. 15 17	Rs. A. P. 18 9 0	Rs. A. P. 45 5 0	Rs. A. P. 193 10 11	Rs. A. P. 193 10 11	13th January 1918.	13th January 1918.	Toria stables irrigated on 1st February 1917.
DF	4 F American	3,320	8	3,296	144.9	638.54	638.17	12 60	20 5 0	35 12 3	156 14 11	158 1 3	1st January 1918.	1st January 1918.	Ploughed with the Raja plough on 7th February 1917.
DF	40 Rosea	3,320	42	3,194	164.6	719.74	748.44	15 10	18 7 9	37 5 2	162 3 1	168 11 4	19th December 1917.	19th December 1917.	Sohaga on 15th February 1917.
DF	4 F American	3,320	...	3,320	183	800.39	800.39	12 60	20 5 0	45 5 3	198 4 3	198 4 3	19th December 1917.	19th December 1917.	Harrowed on 10th February 1917.
CE	Khanna	3,320	...	3,320	240	1,049.55	1,049.55	14 53	18 1 4	52 14 9	231 7 3	231 7 3	8th December 1917.	8th December 1917.	Desi plough on 19th February 1917.
CE	4 F American	3,320	5	3,305	160.4	701.64	704.82	12 60	20 5 0	39 10 9	173 12 10	174 9 5	25th November 1917.	25th November 1917.	Harrowed on 2nd March 1917.
CE	280 F	3,320	...	3,320	157.2	687.51	687.51	10 43	17 0 3	33 9 7	142 8 6	142 8 6	25th November 1917.	25th November 1917.	Sohaga on 11th March 1917.
CE	4 F American	3,320	...	3,320	210.8	921.76	921.76	12 60	20 5 0	52 1 3	228 6 9	228 6 9	16th November 1917.	16th November 1917.	Desi plough on 18th March 1917.
BD	22 Mollisoni	1,168	...	1,168	243.8	1,031.15	1,031.15	15 17	18 9 0	56 7 10	226 11 8	226 11 8	6th November 1917.	6th November 1917.	Harrowed on 23rd March 1917.
BD	4 F American	1,168	...	1,168	178.9	741.17	741.17	12 60	20 5 0	44 4 9	183 9 6	183 9 6	6th November 1917.	6th November 1917.	Harrowed on 27th March 1917.
BC	40 Rosea	1,168	75	1,093	192.2	796.53	851.18	15 60	18 7 9	43 8 5	179 8 10	191 13 11	29th October 1917.	29th October 1917.	Sohaga on 7th April 1917.
BC	4 F American	1,168	...	1,168	219.3	908.78	908.78	12 60	20 5 0	52 12 9	225 1 10	225 1 10	27th October 1917.	27th October 1917.	Irrigated for sowing on 4th April 1917.
AC	Khanna	1,168	119	1,049	199.6	827.10	921.32	14 53	18 1 4	44 0 3	182 6 4	203 2 10	20th July 1917.	20th July 1917.	Harrowed twice on 9th April 1917.
AC	4 F American	1,168	9	1,158	193.8	802.98	809.68	12 60	20 5 0	47 15 11	198 10 11	200 9 1	12th October 1917.	12th October 1917.	Desi plough and Sohaga on 11th April 1917.
AC	280 F	1,168	3	1,165	196.6	814.72	816.37	10 43	17 0 3	41 15 9	168 14 5	169 3 11	2nd October 1917.	2nd October 1917.	1st water on 8th June 1917.
AC	4 F American	1,168	...	1,168	198.8	823.8	823.8	12 60	20 5 0	49 2 1	204 1 0	204 1 0	27th January 1918.	27th January 1918.	Hoeed with horse hoe on 11th June 1917.
AC	4 F American	1,168	...	1,168	198.8	823.8	823.8	12 60	20 5 0	49 2 1	204 1 0	204 1 0	1st February 1918.	1st February 1918.	Hoeed on 5th July 1917.
AC	4 F American	1,168	...	1,168	198.8	823.8	823.8	12 60	20 5 0	49 2 1	204 1 0	204 1 0	1st February 1918.	1st February 1918.	Water on 31st July 1917.
AC	4 F American	1,168	...	1,168	198.8	823.8	823.8	12 60	20 5 0	49 2 1	204 1 0	204 1 0	1st February 1918.	1st February 1918.	Hoeed on 17th August 1917.

* Desi was selling at Rs. 15-12-0 per maund on a basis of 12 seers of lint, and Re. 0-14-0 were allowed as a premium for every extra seer of lint; and the American at Rs. 19-6-2 on 12 seers lint basis with Re. 1-4-0 for extra seer of lint.

Statement No. 3.

STATEMENT SHOWING THE COMPARATIVE OUTTURN OF WHEAT TYPES TRIED AT THE SARGODHA SEED FARM IN RABI 1917-18.

Name of plot.	Name of variety.	Area reaped in square yards.	Average tillering.	ACTUAL OUTTURN IN LBS.		OUTTURN PER ACRE IN LBS.		Ratio of grain to Bhusa.	REMARKS.
				Grain.	Bhusa.	Grain.	Bhusa.		
G. H. I. J. K. ...	Wheat No. 11.	30,837	12	11,801	22,220	1,883	3,545	1:1.882	Stand fair.
Ditto ...	* 8 A	4,703	11	2,065	3,925	2,125	4,039	1:1.905	Stand good.
Ditto ...	8 B	4,703	9	1,752	3,312	1,803	3,408.449	1:1.890	Stand fair.
Ditto ...	17 B	4,703	11	1,674	3,828	1,723	3,940	1:2.287	Stand good.
Ditto ...	9 C	4,703	10	1,528	3,067	1,573	3,156	1:2.006	Stand bad.
Ditto ...	20 C	4,703	11	1,788	3,351	1,840	3,449	1:1.874	Stand good, sheds grain with the least possible jerk so not good for ordinary cultivation.
Ditto ...	Pusa 12	4,703	9	1,592	2,598	1,636	2,674	1:1.632	Stand very fair.

(1) First ploughing on 5th May 1917 to 10th May 1917 with the Raja plough,

(2) Harrowing with S. T. harrow = 5,

(3) Ploughing with Country plough = 3,

(4) Watering after sowing = 2,

(5) Harrowing = 2,

(6) Weeding = 1,

(7) Sown on 24th to 27th October 1917, 11th November 1917 to 27th November 1917,

(8) Harvested on 29th April 1918 to 5th May 1918.

;

RM

2

Rainfall

Total	...	25.30
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IN RABI 1917-18 (ONE AND TWO WATERINGS AFTER SOWING).

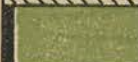
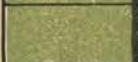
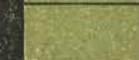
10

2

Total	25.30
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Statement No 6.

Condition of land under wheat varietal tests at Sargodha Seed Farm.

Name of Type.	City Side		City Side	
No. II				II
Pusa 12				8A
II				II
20 C				8B
II				II
17B				9C
II				II
9C				17B
II				II
8B				20C
II				II
8A				12 Pusa
II				II
Pusa 12				8A
II				II
20 C				8B
II				II
17B				9C
II				II
9C				17B
II				II
8B				20C
II				II
8A				12 Pusa
II				II

Good, Average, Bad, compare 6:5:4 in outturn.

Note.

REFERENCES.

Good 
 Average 
 Bad 
 Water Course... 

Appendix VIII.

Report of the Deputy Director of Agriculture, Punjab, Hansi, on the Hansi farm.

Introductory.—The Hansi Farm is primarily a cotton farm and about two-fifths of the whole area is put under various experiments with cottons every year. In the varietal test experiment we are at present trying 9 desi and 4 American cottons. The soil of the farm is very uneven in nature, which makes it very difficult to arrive at accurate results.

Season and its effects.—The total rainfall on the Hansi Farm during the year under report was 36·07 inches (*vide* statement No. 1) as compared with 20·14 inches of the last year and 4·59 inches of the year before, *i. e.* (1915—1916). But the rain was very unevenly distributed during this year, and out of the total 36·07 inches, about 34 inches of rain was received between the months of June and October and only about two inches during the rest of the year. This heavy rainfall in summer did very considerable damage to all the kharif crops, except sugarcane. Our cotton fields were simply swamped out with water, and our experiments with this crop—the chief crop of the farm—became practically of no value, the crop being continually in water during its growing period. The outturns were very much less as compared with the previous years, and the quality was equally bad, most of the seed was not fit for the next kharif sowings. In the “Ilaqa” there is a regular famine of cotton seed for sowing.

Similar was the case with our jowar, bajra and groundnut crops, gawara also yielded very poorly. The heavy summer rains were, however, useful for the rabi crops, though the absence of the winter rains was much felt; and this specially affected the yield of barani crops, which was much reduced. The season was favourable for nahri crops, the supply of water in canal being good and the rainless season saving the crop from rust and other fungoid diseases.

Cottons.—About 41 acres of cottons were grown at the farm under various experiments. As already mentioned owing to the very abnormal conditions of rain during the summer the crop was damaged badly and no reliable results could be obtained. The varieties tried this year were all from those tried in the previous year.

Plant to plant selection.—From 58 rows raised from 58 selected plants of the last year, further selection was made during the year. From these rows 150 plants were selected in the field and out of these only 38 giving a ginning percentage of over 41 per cent. are kept for next year's sowings, the remaining have been rejected. Last year plants having ginning percentage above 35 were selected as compared with 41 of this year, and the highest ginning percentage obtained last year was 43·5 as compared with 47 of this year. This work is of great economic and commercial value, and we will now multiply this seed as well as continue further selections. In all cases, where for reasons, American cotton cannot be grown, this variety should be of great use.

Cambodia cotton was tried here for three successive years. The plants look healthy and flower usually late in the season. It has given practically no outturn.

Wheats.—There were 21 acres of wheat under various experiments. This includes 3 acres of barani wheat and an acre of permanent wheat plot

Varietal Test.—Eight varieties of wheat, *i. e.*, 8-A, 8-B, 9-C, 17-B, 20-C, Punjab 11, Punjab 17, Pusa 12 were tried against Punjab 14, the local wheat. The varieties were sown in triplicate. The average yields of varieties per acre are as follows in order of outturns. For full details please see Statement 2 :—

Varieties.				Mounds	Strs
8-A	...	...	...	31	9
Punjab 11	...	...	...	29	33
Punjab 17	...	...	...	27	33
Punjab 14	...	...	...	27	34
Pusa 12	...	...	...	27	14
9-C	...	...	...	27	1
17-B	...	...	...	25	14
20 C	...	...	...	25	6
8-B	...	...	...	21	3

N.B.—The germination in case of 8-B was only about 50 per cent., and its low yield is not due to its naturally inferior cropping power.

Deep and shallow cultivation.—Three plots of one acre each were ploughed up with country, Rajah and Sabul plough, respectively, and were sown with Pusa-12. The outturn as given below show that the deeper ploughing resulted in the increase of yield of both grain and bhusa.

For full details see please Statement 3.

			Grain		Bhusa	
			Md	Srs.	Mds.	Srs.
Country plough ...	...	...	26	0	39	17
Rajah plough ...	...	...	28	0	41	22
Sabul Plough ...	...	..	31	37	61	29

Sowings of wheat by various methods.—The usual custom is to sow wheat with nali behind the plough, and then leave the furrow open. This does not allow harrowing of wheat to advantage, as the harrowing can be best done when the surface is flat. Again if Sohaga is run over it, the seed goes too deep. This experiment was therefore tried with a view to find the best method of sowing. Punjab 14 was sown with Akola drill, Lyallpur drill, Poona drill, Munna adjusted and Sohaga, and also in the local method leaving the furrow open; and then Sohaga afterwards. The observations were made at the time of germination; germination was uniform in the case of Akola, Poona and Lyallpur drills in the order they are mentioned.

I am working at a new type of drill and trials will be made with it next season.

Plots Nos. 4, 6 and 8 of block E—three acres—were sown with barani wheats, and gave high yields inspite of the very little rain, which was received during their growing period. The high yields were due to proper cultivation, good preparation of seed bed, and preservation of soil moisture by continual harrowing at the proper time.

Barani wheat.

The yields per acre are as follows (for full details please see statement 4) :—

Plot No.		Variety.	Outturn per acre.	
			Mds.	Srs.
4	...	Punjab 14	23	8
6	...	Pusa 12	15	6
8	...	Punjab 14	20	10

Such high outturns of barani wheat are quite a record in this tract.

The same five (5) varieties of sugarcane as grown last year were tried again. These were grown in two sets, in one case Senji (*Melilotus Parviflora*) a leguminous crop, was removed before sowing, in the second case it was ploughed in as green manure.

Sugarcane.

All varieties gave higher yields per acre in the green manured plots, thus confirming last year's results. The average yields per acre of the various varieties are as follows :—

			Senji removed.			Senji ploughed.		
			Mds.	Srs.	Chh.	Mds.	Srs.	Chh.
Suretha	...	...	30	22	7	42	4	0
Lalri	...	...	33	9	10	39	7	4
Mango	...	...	28	20	0	36	24	12
Local	...	...	32	3	3	35	3	4
Dhaura	...	...	26	27	14	34	15	0

For details please see statement 5.

I may also add that in green manured plots last year, Suretha stands 1st, Lalri 2nd Mango 3rd, Local 4th and Phaura 5th and this year's results confirm this statement.

The soil of Hissar District being mostly light and sandy, I obtained 4 varieties of barley from the Economic Botanist which were tried against the local variety. All of these types were found superior to the local variety, and his type No. 2 was the best.

Barley and grams.

For details please see statement 6.

But Economic Botanist was not in a position to hand over any gram varieties yet. Three gram varieties were therefore obtained from Burma and tried against the local variety (in plot 11 of Block D) which gave better yields. However the test will be repeated for another year.

For details please see statement 7.

Nine hundred and twenty-two maunds and thirty-three seers of green jowar was ensilaged in September 1916; this was opened in December 1917 and fed up to March 1918. It kept excellently well although it remained over a year, and passed through a very wet summer. It was greatly relished by the bullocks. The members of the Agricultural Association, Hissar, were shown this, and some promised to try it. In a district like Hissar, which is liable to intermittent fodder famines, this might be of great value especially in the irrigated parts.

Silage.

DARSHAN SINGH,

Deputy Director of Agriculture, Punjab, Hiansi

Statement No. 1.

SHOWING THE RAINFALL DURING THE YEAR 1916-17 AND 1917-18 ON THE HANSE
AGRICULTURAL STATION.

1	2	3	4
Name of month.	Rainfall during 1916-17.	Rainfall during 1917-18.	REMARKS.
June ...	1.14	3.23	
July ...	2.97	2.73	
August ...	7.44	4.93	
September ...	2.88	15.31	
October ...	2.42	7.61	
November ...	...	...	
December ...	...	.09	
January ...	.09	.45	
February ...	.38	.05	
March ...	...	1.59	
April ...	1.73	.08	
May ...	1.09	...	
TOTAL ...	20.14	36.07	

Statement No. 2.

SHOWING THE RESULT OF VARIETAL TEST OF WHEAT CARRIED OUT AT HANSI AGRICULTURAL STATION DURING RABI 1917-18.

Block AND Plot No.	Block.	Name of type.	Previous crop.	DATE OF		Area sown in acres.	Area harvested in acres.	ACTUAL OUT TURN.						OUTTURN PER ACRE.						OUTTURN PER ACRE IN TERMS OF STANDARD						REMARKS.			
				Sowing.	Harvesting.			GRAIN.			BRUSA.			GRAIN.			BRUSA.			GRAIN.			BRUSA.						
								Indian.	English.	Lbs.	Maunds.	Seers.	Lbs.	Indian.	English.	Lbs.	Maunds.	Seers.	Lbs.	Indian.	English.	Lbs.	Maunds.	Seers.	Lbs.		Indian.	English.	Lbs.
1 and 2 1		Pb. 14	4-F Cotton	18th November 1917.	15th April 1918..	2	2	1	29½	142.47	5	3	416.15	23	18½	1,922.90	68	20	5,617	28	18	1,922.90	68	20	5,617	Ploughings=6. Harrowings=12. Sowings=3. Waterings=3. Hoings=2. and Weedings=2.			
1 and 2 2		8-A ..	Do.	Ditto	15th April and 18th April 1918.	2	2	2	17½	199.87	5	19	448.95	32	36½	2,697.80	73	37	6,001.85	26	29½	2,192.47	70	21	5,783.05				
1 and 2 3		Pb. 14 ..	Do.	Ditto	15th April 1918	2	2	2	9	182.45	5	15	440.75	30	11½	2,462.05	72	22	5,949.10	30	1	2,462.05	72	22	5,949.10				
1 and 2 4		8-B ..	Do.	Ditto	21st April 1918..	2	2	1	12½	107.62	3	14½	275.72	17	28½	1,452.93	45	15½	3,722.28	29	34½	2,448.72	76	4	6,240.20				
1 and 2 5		Pb. 14 ..	Do.	Ditto	10th and 15th April 1918.	2	2	2	8	180.40	5	36	483.80	29	28	2,435.40	79	26	6,531.30	29	28	2,435.40	79	26	6,531.30				
1 and 2 6		9-C ..	Do.	Ditto	10th and 15th April 1918.	2	2	2	6	176.80	6	6	504.30	29	1	2,380.05	83	1	6,808.05	30	1½	2,463.07	78	5	6,408.25				
1 and 2 7		Pb. 14 ...	Do.	Ditto	16th and 17th April 1918.	2	2	2	10	184.50	5	27	465.35	30	15	2,490.75	76	24	6,281.20	30	15	2,490.75	76	24	6,281.20				
1 and 2 8		17-B ..	Do.	Ditto	Ditto	2	2	1	38	159.90	7	20	615	26	13	2,158.65	101	10	8,284.05	29	21	2,421.05	86	29	7,111.45				
1 and 2 9		Pb. 1 ..	Do.	Ditto	18th April 1918	2	2	2	5	174.25	7	7	588.35	28	27	2,351.35	96	34	7,941.70	28	27	2,351.35	96	34	7,941.70				
1 and 2 10		20-C ..	Do.	Ditto	Ditto	2	2	1	29	141.45	6	24	541.20	23	11	1,908.55	89	4	7,306.20	29	1	2,379.02	92	39	7,522.95				

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A—contd.

1 and 2 19	8-A ...	Do.	Ditto	Ditto	2 27	8,133 43,560	1	82	147-60	3	7	260-35	25	1	2,052-15	44	6	3,620-30	27	20½	2,256-02	45	87	3,765-86
1 and 2 20	Pb. 14 ...	Do.	Ditto	Ditto	2 27	3,290 43,560	1	39	161-95	3	8	262-40	26	35	2,203-75	43	22	3,571-10	26	35	2,203-75	43	22	3,571-10
1 and 2 21	8-B ...	Do.	Ditto	21st April 1918	2 27	3,067 43,560	1	0	82	2	4	172-20	14	8	1,164-40	29	33	2,445-65	26	17½	2,167-87	43	8½	3,538-17
1 and 2 22	Pb. 14 ...	Do.	Ditto	9th and 15th April 1918.	2 27	3,141 43,560	1	35	153-75	3	3	252-15	25	0	2,132	42	25	3,495-25	23	0	2,132	42	25	3,495-25
1 and 2 23	9-C ...	Do.	Ditto	Ditto	2 27	3,123 43,560	1	30	143-50	3	2	250-10	24	16	2,000-80	42	21	3,487-05	24	11½	1,991-57	40	34½	3,850-72
1 and 2 24	Pb. 14 ...	Do.	Ditto	Ditto	2 27	2,267 43,560	1	7	96-35	2	1	166-05	22	23	1,851-15	38	36	3,159-30	22	23	1,851-15	38	36	3,159-30
1 and 2 25	17-B ...	Do.	Ditto	10th April 1918	2 27	2,107 43,560	1	4	90-20	2	5	174-25	22	29	1,863-45	43	37	3,601-85	23	13	1,912-65	40	19	3,318-95
1 and 2 26	Pb. 14 ...	Do.	Ditto	9th and 13th April 1918.	2 27	2,667 43,560	1	19	120-95	2	23	211-15	24	3	1,974-15	42	2	3,443-10	24	3	1,974-15	42	2	3,443-10
3 and 4 18	Pb. 14 ...	Do.	Ditto	13th and 17th April 1918.	2 27	2,427 43,560	1	15	112-75	2	20	205	24	27	2,023-35	44	34	3,677-70	24	27	2,023-35	44	34	3,677-70
3 and 4 19	20-C ...	Do.	Ditto	Ditto	2 27	2,811 43,560	1	23	135-30	3	0	246	25	22	2,095-10	46	19	3,810-95	25	37½	2,126-87	46	32½	3,838-62
3 and 4 20	Pb. 14 ...	Do.	Ditto	9th and 13th April 1918.	2 27	3,081 43,560	1	37	157-85	3	18	252-90	27	8	2,230-40	43	31	3,999-55	27	8	2,230-40	48	31	3,995-45
3 and 4 21	Pb. 11 ...	Do.	Ditto	Ditto	2 27	3,163 43,560	2	7	173-35	3	16	278-80	29	38	2,455-90	46	32	3,837-60	26	14	2,160-70	46	21	3,815-05
3 and 4 22	Pb. 14 ...	Do.	Ditto	14th and 17th April 1918.	2 27	3,074 43,560	1	32	147-30	3	5	256-25	25	20	2,091	44	11	3,680-55	25	20	2,091	44	10	3,628-50
3 and 4 23	Pb. 17 ...	Do.	Ditto	14th April 1918	2 27	3,163 43,560	1	39	161-95	3	31	309-55	27	7	2,223-35	51	39	4,261-95	26	1	2,134-05	51	14½	4,211-72
3 and 4 24	Pb. 14 ...	Do.	Ditto	17th April 1918	2 27	3,074 43,560	1	35	153-75	4	5	338-25	26	22	2,177-10	53	18	4,792-90	26	22	2,177-10	58	18	4,792-90
3 and 4 25	Pusa 12...	Do.	Ditto	9th and 14th April 1918.	2 27	3,100 43,560	1	30	143-50	3	33	313-65	24	23	2,015-15	53	29	4,405-45	23	23	1,933-45	46	25½	3,524-23
3 and 4 26	Pb. 14 ...	Do.	Ditto	14th and 17th April 1918.	2 27	2,907 43,560	1	15	112-75	2	13	190-65	20	24	1,689-20	34	33	2,855-65	20	24	1,689-20	34	33	2,855-65

Statement No. 3.

SHOWING THE EFFECT OF DEEP AND SHALLOW CULTIVATION EXPERIMENT ON WHEAT GROWN AT HANSI AGRICULTURAL STATION DURING RABI 1917-18.

Block and Plot No.		Name of type.	Treatment.	Previous crop.	Area sown in acres.	ACTUAL OUTTURN.						OUTTURN PER ACRE.						REMARKS.
Block.	Plot.					GRAIN.			BHUSA.			GRAIN.			BHUSA.			
		Indian weight.	English weight.	Indian weight.	English weight.	Indian weight.	English weight.	Indian weight.	English weight.	Indian weight.	English weight.	Indian weight.	English weight.	Indian weight.	English weight.			
						Mounds.	Seers.	Lbs.	Mounds.	Seers.	Lbs.	Mounds.	Seers.	Lbs.				
D.	8	Pusa 12	Country plough	Grams	1	26	0	2,132	39	17	3,232.85	26	0	2,132	39	17	3232.85	Ploughings ... 4
	9	Pusa 12	Raja plough 4 1/2"	Do.	1	28	0	2,296	41	22	3,407.10	28	0	2,296	41	22	3407.10	Harrowings ... 11
	10	Pusa 12	Sabul plough 9"	Do.	1	31	37	2,617.85	61	29	5,061.45	31	37	2,617.85	61	29	5061.45	Sobagings and weedings ... 11 Date of sowing - 16th November 1917. Date of harvesting - 12th April 1918.

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Statement No. 4.

SHOWING THE RESULT OF BARANI WHEATS GROWN AT HANSI AGRICULTURAL STATION DURING RABI 1917-18.

Block and Plot No.		Name of variety.	Area sown in acres.	Area harvested in acres.	ACTUAL OUTTURN.						OUTTURN PER ACRE.						REMARKS.
					GRAIN.			BHUSA.			GRAIN.			BHUSA.			
					Indian weight.		English weight.	Indian weight.		English weight.	Indian weight.		English weight.	Indian weight.		English weight.	
					Mounds.	Seers.	Lbs.	Mounds.	Seers.	Lbs.	Mounds.	Seers.	Lbs.	Mounds.	Seers.	Lbs.	
B.	4	Wheat, Pb. 14	1	31,485	16	80	1,373.50	31	0	2,542	23	8	1,902.4	42	38	3,521.90	Ploughings ... 6 Harrowings ... 18 Sobagings ... 9 Hoelings ... 2
	6	Wheat, Pusa 12	1	37,630	11	15	932.75	17	20	1,435	15	6	1,242.30	23	13	1,912.65	Plot 4, Plot 6, Plot 8.
	8	Wheat, Pb. 14	1	43,560	17	20	1,435	30	10	2,480.50	20	10	1,660.50	35	1	2,872.05	Date of sowing—7-11-17, 13-11-17, 7-11-17. Date of harvest—12-4-18, 5-4-18, 15-4-18, 15-4-18.

Statement No 5.

SHOWING THE RESULTS OF VARIETAL EXPERIMENT WITH SUGARCANE DURING THE KHARIF 1917.

Block and Plot No.	Treatment before sowing.	Variety.	Actual area sown.	Area harvested in acres.	ACTUAL OUTTURN OF						OUTTURN PER ACRE OF						Percentage of gur to juice.	Percentage of juice to cane.	Percentage of gur to cane.	REMARKS.				
					Unstripped canes.		Tops.		Stripped canes.		Juice.		Gur.		Stripped canes.						Juice.		Gur.	
					Mounds.	Seers.	Mounds.	Seers.	Mounds.	Seers.	Mounds.	Seers.	Mounds.	Seers.	Mounds.	Seers.					Mounds.	Seers.	Mounds.	Seers.	Lbs.
19a1	Senji removed.	Localikh	...	...	64	38½	10	35½	44	31	26	5	4	32	358	29,372.40	209	0	17,138	3,148.80	18.37	10.72		
19a2		Mango	...	...	37	33	9	10	24	14	14	8	2	20½	290	23,801.74	169	27½	13,915.29	2,452.82	17.62	10.27		
19a3		Lalri	...	...	56	5	9	38	37	24	21	17	3	31½	363	29,886.34	210	33½	17,247.67	3,048.99	17.67	10.21		
19a4		Dhaura	...	...	39	7	8	21	24	16½	13	30	2	10½	352	28,892.18	188	26½	16,289.81	2,410.15	14.79	8.34		
20a1		Suretha	...	...	51	32½	9	32	34	5	20	29	3	10½	375	30,780.75	227	39	18,693.95	2,945.59	15.77	9.55		
20a2	Senji ploughed in as green manure.	Localikh	...	...	81	4	11	14½	54	5½	30	39½	5	10	433	35,514.20	247	38	20,327.80	3,444	18.94	9.69		
20a3		Do.	...	...	81	32½	14	16½	64	4	31	32	5	10	432	35,482.20	254	16	20,360.80	3,292.30	15.79	9.29		
20a4		Mango	...	...	76	5	15	20	50	4	30	4	4	33½	400	32,865.60	240	32	19,745.60	3,168.27	16.04	9.64		
21a1		Lalri	...	...	61	36	10	39	39	37	23	20	3	27½	439	36,012.35	258	20	21,197	3,826.12	15.69	9.23		
21a2		Dhaura	...	...	72	29	14	24	43	8½	25	20	0	14	345	28,347.4	200	0	16,400	2,648.6	16.15	9.34		
21a3	Senji Removed.	Suretha	...	...	86	16	18	36	52	25	29	20	5	15	421	34,522	236	0	19,352	3,523	18.22	10.21		
21a4		Localikh	...	...	60	35	13	24	40	10½	22	20	3	23	322	26,412.20	180	0	14,760	2,345.20	15.88	8.87		
19b1		Localikh	...	...	20	20	4	6	13	7½	7	0	1	12½	240	19,750.34	127	33½	10,433.57	1,965.56	18.75	9.95		
19b2		Mango	...	...	55	35½	13	9	34	38	18	24	3	15½	279	22,927.20	136	32	12,201.60	2,221.17	18.20	9.68		
19b3		Lalri	...	...	64	28½	8	27	39	36½	21	25	3	26½	319	26,166.20	175	0	14,186	2,402.60	16.98	9.18		
20b1	Senji ploughed in as green manure.	Dhaura	...	...	44	35	9	15½	28	29	14	24	2	19½	278	22,800.74	141	13½	11,588.77	1,968.26	16.98	8.63		
20b2		Suretha	...	...	50	6	8	12½	35	2	18	20	3	6	280	22,992.80	148	0	12,136	2,066.40	17.02	8.98		
20b3		Localikh	...	...	43	13½	7	12	30	22½	16	7	2	39½	244	20,049	129	16	10,610.80	1,963.90	18.60	9.79		
20b4		Do.	...	...	54	17½	7	21½	38	1½	20	37	3	2½	304	24,952.60	167	16	13,726.80	2,408.75	17.54	9.65		
20b4		Mango	...	...	74	9	13	27½	48	26½	28	17	4	13	389	31,922.60	227	16	18,546.80	2,837.20	15.21	8.89		
21b1	Senji ploughed in as green manure.	Lalri	...	...	76	32	13	33	51	1	27	33	4	29	408	33,472.40	232	14	14,253.20	2,899.60	16.96	9.26		
21b2		Dhaura	...	...	77	20½	13	31	49	38	31	0	4	22½	399	32,767.20	243	0	20,236	2,988.90	14.99	9.12		
21b3		Suretha	...	...	92	36	19	20	53	0	33	30	5	6	424	34,768	249	0	22,140	3,378.40	15.26	9.71		
21b4		Localikh	...	...	84	3	12	39	54	22	31	27½	5	11	436	35,784.80	253	20	20,787	3,460.40	16.64	9.67		

Ploughings
Harrowings
Subagains
Hoogings and weedings
Waterings

3
1
12
12
6

XXXX

Statement No. 6.

SHOWING THE RESULTS OF VARIETAL TEST OF BARLEY GROWN AT HANSI AGRICULTURAL STATION DURING RABI 1917-18.

Block and Plot No.	Block.	Plot.	Name of variety.	Area sown in acres.	Area harvested in acres.	ACTUAL OUTTURN.						OUTTURN PER ACRE.						REMARKS.
						GRAIN.			BRUSA.			GRAIN.			BRUSA.			
						Indian.		English.	Indian.		English.	Indian.		English.	Indian.		English.	
						Maunds.	Seers.	Lbs.	Maunds.	Seers.	Lbs.	Maunds.	Seers.	Lbs.	Maunds.	Seers.	Lbs.	
15 a			Barley Local	16	16	0	28	57.40	1	10	102.50	7	0	574	12	20	1,025	Ploughings ...
15 b			Type No. 1	16	16	1	18½	109.67	2	10	184.50	13	15	1,096.75	22	20	1,845	Harrowings ...
15 c			Local	16	16	0	37½	76.61	1	30	143.50	9	13½	766.18	17	20	1,435	Sodagings ...
15 d			Type No. 2	16	16	1	19	120.95	2	15	194.75	14	30	1,209.50	23	30	1,947.50	Hoings ...
15 e			Local	16	16	0	35	71.75	1	28	139.40	8	30	717.50	17	0	1,394	Waterings ...
15 f			Type No. 4	16	16	1	14	84.56	2	0	164	10	12½	845.62	20	0	1,540	Date of sowing--16th October 1917.
15 g			Local	16	16	0	32	65.60	1	17	116.85	8	0	656	14	10	1,068.50	28th March 1918.
15 h			Type No. 5	16	16	1	6½	95.32	1	38	159.90	11	25	953.25	19	20	1,599	Date of harvesting {
15 i			Local	16	16	0	35½	72.26	1	25	133.25	8	32½	722.62	16	10	1,332.50	29th March 1918.

Statement No. 7.

SHOWING THE RESULTS OF COMPARATIVE TEST OF LOCAL AND BURMA GRAMS GROWN AT HANSI AGRICULTURAL STATION DURING RABI 1917-18.

Block AND PLOT NO.	Plot.	Name of variety.	Area sown in acres.	Area harvested in acres.	ACTUAL OUTTURN.						OUTTURN PER ACRE.						REMARKS.	
					GRAIN.			BHUSA.			GRAIN.			BHUSA.				
					Indian.	English.	Maunds.	Seers.	Lbs.	Maunds.	Seers.	Lbs.	Indian.	English.	Maunds.	Seers.		Lbs.
11 a	Local grams	...	‡	$\frac{6,116}{43,560}$	2	7½	179.37	3	26½	300.32	15	23½	1,277.53	26	3	2,188.15	Ploughings Harrowings Sohagaings Hoings and weedings Watering	
11 b	White Burma, No. 2	...	‡	$\frac{4,180}{43,560}$	1	16½	115.82	2	10½	185.62	14	29	1,207.45	23	23	1,939.15	...	
11 c	Local grams	...	‡	$\frac{3,740}{43,560}$	1	17	110.85	2	16	196.80	16	24	1,361.2	27	88	2,291.9	...	
11 d	Black Burma	...	‡	$\frac{1,940}{43,560}$	0	21½	41.07	0	38½	78.92	12	2½	989.63	21	24	1,771.2	...	
11 e	White Burma, No. 1	...	‡	$\frac{5,060}{43,560}$	1	30	143.50	2	38	241.90	15	2½	1,235.35	25	15	2,080.75	...	
11 f	Local grams	...	‡	$\frac{6,260}{43,560}$	2	38½	232.67	4	21½	372.07	19	29½	1,618.21	31	23	2,589.15	...	

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**Report on the Operations of the
Department of Agriculture, Punjab,
for 1918-19.**

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REPORT

ON THE OPERATIONS OF THE

DEPARTMENT OF AGRICULTURE, PUNJAB,

FOR THE YEAR ENDING 30TH JUNE 1919.



Lahore :

PRINTED BY THE SUPERINTENDENT, GOVERNMENT PRINTING, PUNJAB.

1919.

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receive the 1920 crop. He is also gratified to observe that the Director has in co-operation with the Director-General of Aeronautics been able to make a beginning in the utilization of aerial photography for the purpose of crop surveys.

9. The reputation which the Agricultural Department is building up for itself is based upon the industry and ability of the expert officers of the department and also upon their readiness to co-operate with other departments, with district officers and with the public. The past year has not failed to place this reputation on a still higher level than before. Sir Edward Maclagan is confident that in the large expansion of the department's activities which is likely to take place in the not distant future these qualities will be fully maintained. During the greater part of the year under review the post of Director has been held by Mr. Jacob whose qualifications have been fitly described by Mr. Maynard in his review. The Lieutenant-Governor endorses the Financial Commissioner's appreciation of his work and anticipates an era of substantial progress and fruitful achievement during his Directorship.

ORDER.—Ordered that a copy of these remarks be forwarded to the Senior Secretary to the Financial Commissioners, Punjab, for the information of the Financial Commissioners, that they be published in the *Punjab Gazette* and submitted with copies of the report to the Government of India in the Department of Revenue and Agriculture.

By order of His Honour the Lieutenant-Governor of the Punjab,

E. JOSEPH,

Revenue Secretary to Government, Punjab.

maunds. The work of the Economic Botanist on cottons and wheats has been productive of valuable results during the year. Mr. Milne reports that another improved American cotton, 285-F, which has cropped more heavily than 4-F, and has an equally good ginning percentage and a much better lint, is now attracting the attention of farmers. This cotton is undoubtedly a promising type both for farmers and spinners, and further experiments are being made with it on a field scale. Among wheats No. 8-A and No. 11 are being extensively tested. At the Lyallpur experimental farm Punjab-11 for the first time in four years gave a better yield than No. 8-A and Mr. Roberts wisely calls attention to the need for caution before the latter can be accepted and extensively advertised as an improvement on the former. Nonetheless, as Mr. Milne notes, there appears to be good ground for the opinion where the test plots have been most closely comparable, that 8-A may be the heaviest cropper. Tests made on a large scale at Delhi showed 8-A to be a very good milling wheat though the tests made in 1917 in England on smaller samples put 8-A very low compared with Pusa-12 or Punjab-11. Both sets of experiments put the milling properties of 8-B at the top, but it is apparently a less heavy yielder than either 8-A or Punjab-11. The results of further tests of this wheat will therefore be watched with interest.

5. The rise in prices has caused a further decrease in the sales of imported implements and has also checked the sales of implements made by the department. Government has recently conveyed administrative sanction to the construction of a new engineering workshop at the Lyallpur College, and His Honour is confident that Mr. Miller-Brownlie's fertility of mind in designing new types of implements will be utilized to much greater advantage when this workshop is ready. Well-boring work shows an improvement over the previous year in spite of the despatch of much needed staff and plant to Persia in response to a call made by the Army Department. This reduction of staff and plant proved detrimental to tube-well work, for which suitable mechanics are also reported difficult to obtain. In the interests of the current year's work it is to be hoped that the plant will be replaced at an early date.

6. Demonstration farms are now being started in numerous districts with the help of contributions made by Government for initial expenditure out of the wheat profits. In addition to this the vogue of demonstration plots in which a zamindar's holding is cultivated under the supervision of the department has proved popular in Gurdaspur and elsewhere. In view of the time, money and energy which these demonstration farms may be expected to absorb in the future it is wise to lay some emphasis on the timely criticisms of the Director and of the Financial Commissioner in regard to them. The former in discussing the views of the Professor of Agriculture which are adverse to demonstration farms draws the conclusion that demonstration should invariably be preceded by careful research in a place of similar soil and climate to that in which the demonstration is to be given. Mr. Maynard draws attention to the financial aspect of demonstration work and the need for combining the demonstration of financial results with the demonstration of agricultural method and adduces in support of his contention the growing importance of the commercial aspect of farming on a large scale. These are both cogent criticisms on aspects of the subject which should not be lost sight of, and they deserve careful attention from those who will be responsible for the actual management of these farms.

7. An interesting paragraph of the Director's report describes the operations of the department in connection with the purchase and import of millet seed. 6,000 maunds were imported of which the department sold only 400 maunds as the mere import broke the ring which the trade had formed and prices fell so rapidly that Government was undersold. The consequent loss incurred by Government amounts to about Rs. 25,000 but should serve as an object lesson of the value of co-operative purchase of seed. When the department's seed arrived, prices after having been as high as Rs. 12 to Rs. 14 a maund, ruled at about Rs. 9 or Rs. 10 a maund, and in a week fell to half this figure.

8. The Lieutenant-Governor is glad to see from the report that there is a possibility of the Lyallpur elevator being ready for work in May next to

Proceedings of His Honour the Lieutenant-Governor, Punjab, in the Department of Revenue and Agriculture, No. 24166, dated 10th November 1919.

READ—Letter No. 491-50-G-2, dated 11th October 1919, from the Junior Secretary to Financial Commissioners, Punjab, forwarding with the remarks of the Financial Commissioner the annual report on the operations of the Department of Agriculture in the Punjab for the year ending 30th June 1919.

REMARKS.—Government has this year sanctioned an alteration in the form of the report on the operations of the Department of Agriculture. The report under review and all future reports will consist of two parts. The first will comprise the Director's own report together with brief non-technical summaries of the year's work by the experts of the department, any statistics considered necessary being included in the text. The second part will be an Annual Experimental Record, consisting of a scientific description by each expert of the research or other work undertaken by him during the year and including also all the prescribed statistical statements. This second part will, it is hoped, furnish a complete scientific description of the experiments performed which will be available for consultation by those specially interested.

2. The popularity of the Punjab Agricultural College, Lyallpur, is indicated by the large number of applications for admission, namely, 265 or 42 more than in the previous year. The College is at present equipped for the admission of 38 students a year, but in view of the extensions contemplated in the near future it was decided to admit 56 applicants this year. An encouraging feature is the preponderance for the first time of agriculturists among the applicants. It is hoped with an extension of the chemical block and an increase of staff, to provide for an ultimate admission of at least 90 students a year. Both the College authorities and the students themselves are to be congratulated on the excellent spirit maintained at the College during the disorders of last April. Passed students of the College continue to do extremely well in Government and private service and valuable work is also being done in connection with the Vernacular class, the Teachers' class and the Rural Economy class.

3. Deterioration has begun to manifest itself on a small scale in the reclaimed area of the Narwala farm; but as remarked by Mr. Maynard the ultimate re-appearance of the salts on these lands was never doubted and the main question is as to the pace of the relapse and the interval before machining is again necessary. In the Kahuta experiment an important conclusion is now claimed that there is no fundamental constitutional difference between bara soils and the normal cultivated soils situated in their vicinity. The Lieutenant-Governor awaits with interest the fuller information that will be given on this matter in part II of the report. Other important research work being carried out by the Agricultural Chemist is connected with the movement of soil moisture and with experiments on green manuring and on nitrogen fixation; and Sir Edward MacLagan endorses the Director's comment that Mr. Wilsdon has set himself a high standard of research.

4. There has been a further rapid increase in the area sown with 4-F American cotton in the colonies during the year, the total estimated area being 511,000 acres compared with 390,000 acres in 1918. The Lower Jhelum and Lower Bari Doab colonies account for the greater part of the advance. In the latter colony the advantage of sowing cotton in lines is beginning to be appreciated. His Honour regrets to hear that the cottons, especially it would seem Americans, have suffered considerably from shedding their bloom, and forming few or insufficiently developed bolls. The cause of this is under investigation, but he understands that at present the experts are inclined to attribute the circumstance to a physiological condition arising from the sudden cessation of the monsoon at a moment when the available canals supply was being otherwise utilized by the zamindars. Of wheats, Punjab-11 continues to be the most popular in the colonies and the Director has made an interesting calculation that the distribution of pure Punjab-11 seed has improved the colony crop by 60,000

No. 491-50-G-2.

FINANCIAL COMMISSIONERS' OFFICE :

Dated Lahore, 11th October 1919.

FROM

KHAN SAHIB MIAN ABDUL AZIZ,

Junior Secretary to the Financial Commissioners,

Punjab,

TO

THE HON'BLE MR. E. JOSEPH, I.C.S.,

Revenue Secretary to Government, Punjab.

The Hon'ble Mr. H. J. Maynard, C.S.I., I.C.S.

SIR,

IN continuation of this office letter No. 491-50-G-1, dated 7th October 1919, I am directed to forward the Financial Commissioner's Review on the Annual Report on the Operations of the Department of Agriculture, Punjab, for 1918-19.

I have the honour to be,

SIR,

Your most obedient servant,

ABDUL AZIZ,

Junior Secretary to the Financial Commissioners,

Punjab.

Financial Commissioner's Review of the Agricultural Report for 1918-19.

1. The applications and the admissions to the Agricultural College reached the record figures of 265 and 56. It is interesting to find such a large number of applications (69) from the Rawalpindi Division. There are now nine students of the class for whom quarters of a special type, resembling those in the Aitchison College, were recently completed. It is very satisfactory that these youths are doing well as it shows the willingness of the sons of the Punjab aristocracy to put their hearts into what is at present the principal business of the Province. The good behaviour of the students in April and May is a gratifying fact. The excellent material prospects of the passed students of agriculture, for whose services the demand now considerably outruns the supply, account in part for a mental attitude different from that of the student class generally. The large proportion of British among the teaching staff of Lyallpur is also a differentiating factor. Lyallpur students have the opportunity of knowing what an Englishman really is. Since the close of the year Government has given administrative sanction to a large building scheme: and proposals are now being submitted for a great addition to staff, with a view to increasing the number of students and improving the instruction. The effects of affiliation to the University have been seen in the reduction of the main subjects from three to two, permitting of the adoption of a higher standard of work with a more concentrated attention. The teaching given in practical agriculture is again the subject of praise from the examiner.

2. It is remarked by the Director that the Narwala Farm, reclaimed from saline efflorescence by the late Mr. Barnes, is showing signs of relapse. Mr. Barnes always foretold the probability of relapse which would be more rapid if cultivation should become careless. Mr. Roberts has noted the cultivators are janglis and very unprogressive. Two years have now elapsed since the land was handed back, and has reappeared in only 2 acres out of 130, and the average outturn of wheat is still satisfactory. The cost of the reclamation work including depreciation of machinery but not including cost of water, for which the Irrigation Branch made no charge, was Rs. 21,000 round, or about Rs. 160 per acre. If the effect of the operations continues for eight years, the outlay will have been more than justified. The question is: at what pace will lands thus treated revert. That they will ultimately revert has never been doubted.

3. The Kahuta trials present, as the Director has pointed out, far greater difficulties, because of the peculiar quality of the bara soils, which is now shown to be independent of their mechanical composition. The results of the economic experiment in Mr. Barnes' method of deep ploughing and washing are yet to be seen. The appointment of a Deputy Director whose whole attention will be given to the treatment of bara and saline soils at Kahuta is awaited. The Financial Commissioner hopes that this experimental farm will be visited in the course of the coming cold weather by the Imperial Agricultural Chemist and the Imperial Bacteriologist from Pusa.

4. A very important piece of research, in connection with questions of irrigation and water-logging, is that which is being conducted by Mr. Wilsdon, the Agricultural Chemist, into the movement of soil moisture under field conditions. The co-operation of the Agricultural Department with the Irrigation Branch promises to be equally fruitful of results to both departments. But the establishment of the Irrigation Research Farm, from which much is hoped, awaits the time when staff—both Irrigation and Agricultural—will be available. In this connection the Financial Commissioner notes that the results obtained from the special tests applied to the Gibbs' Module at Lyallpur must not be regarded as final. The most satisfactory test would be one applied under the supervision of Mr. Gibb himself.

5. An indication of the variety of the work done by the Agricultural Chemist is given by his discovery, by biological analysis, that the drinking water supply of Lyallpur is badly contaminated. This is of much significance to colony towns which almost without exception obtain their drinking water through filters from the canal. The Financial Commissioner has communicated the facts to the Sanitary Board.

6. An interesting step has been taken by Mr. Milne in carrying through the point of the investigation of milling and baking qualities, the comparison of different types of wheat. The question of the relative advantages of 8-A and Punjab 11 is evidently still to be answered by experience. The Financial Commissioner concurs with Mr. Roberts in his warning that caution is necessary in accepting conclusions. Mr. Maynard has found himself unable to understand the remarks of the Deputy Director of Hansi on the subject of Punjab 11 and Pusa 12. Both seem to be very good wheats. The calculation made by the Director of Agriculture that the crop in the colony was more by 60,000 maunds than it would have been without the distribution of pure Punjab 11 wheat seed is highly suggestive of the benefits conferred by the Department.

7. 4-F. cotton continues to extend and occupies 511,000 acres in the colonies, as against 390,000 last year. 285-F., whose lint is reported as "far better than American middling and good for spinning 50's," did very well on moderately good land. It has the same ginning percentage as 4-F. The hardiness of the plant and its suitability for average soil generally remain to be tested.

8. Mr. Milne's remarks on the need for an alteration of the organisation of the department in order to provide for satisfactory work on the improvement of cottons and other crops will doubtless receive the attention of the Director of Agriculture.

9. The appointment of a whole-time Entomologist at Lyallpur gives hope of a development of sericultural work.

10. Messrs Faulkner and Miller-Brownlie continued to co-operate successfully in the working out of appropriate forms of cheap implements. High prices, and a call made by the Army for water production in Persia, have interfered with the Agricultural Engineer's work. Mr. Miller-Brownlie's investigations into the extent of the cone of suction promise valuable results from the two points of view of lift irrigation and the cure of waterlogging.

11. The advantages of sowing cotton in lines continue to be pressed with success. The system of demonstration plots, of which M. Fateh-ud-din, Deputy Director of Gurdaspur, seems to have made a speciality, is interesting. It seems to the Financial Commissioner doubtful whether the large increase of staff, which any considerable extension of this system postulates, could not be more effectively employed on other forms of demonstration. But he retains an open mind on the question.

12. It is questionable whether demonstration, pure and simple, and with no element of experiment in it, will ever be feasible. It will certainly not be feasible till the results of experience gained in one locality have been verified by further experience gained in the locality where a demonstration farm has been established, and as the department is a progressive one, this process will never come to an end. It appears to follow that demonstration farms must be strongly staffed and well supervised, or their failures may bring discredit on a department whose principal asset is the confidence of the cultivator. But the Financial Commissioner agrees with the Director that Mr. Robert's experience with the progressive cultivators of the colonies may mislead his judgment of the possibility of propaganda without demonstration farms in the Punjab generally.

13. M. Fateh-ud-din has referred to the financial results of two demonstration farms in the tract under his supervision. One has covered its expenses, and the other apparently not. It appears to the Financial Commissioner that this aspect of demonstration is of great importance. It may, no doubt, be urged with truth that the typical Punjab cultivator does not understand figures, and is not influenced by them, and that the cost of working a farm through the agency of Government or a local body is so different from the cost of working one by a cultivator and his family, that the financial results of the one can throw no light on the prospects of the other. But, Mr. Maynard would point out, Punjab farming is just beginning to enter upon a new stage, to which the enterprise and the comparatively large holdings of the colonies have introduced it. It is ceasing to be mere "livelihood" farming and is—though the process has not yet extended very far—beginning to become "commercial" farming, with a dawning interest in improved methods, labour saving devices, modes of transport, and the opportunities of the market. Demonstration of technique and method ought therefore to be accompanied by demonstration of financial results, and the subject of farming costs ought to be included in the curriculum of the Agricultural College.

14. The Director has described in paragraph 18 of his report the results of the purchase of chari seed by Government. There was good reason for the belief that seed would not be available in sufficient quantities: and, though this forecast was not borne out, it appears certain that extremely high prices would have been charged by the dealers, if the Director's operations had not caused a complete slump in the market. The fact that even a firm like Ralli Brothers were unable before the Director's importations to obtain quotations below ten rupees a maund shows how successful speculative holders can be in holding up stocks and maintaining a high level of prices. The Financial Commissioner agrees with the Director that the experience, and the result, were by no means too dearly purchased by a loss of Rs. 25,000.

15. Mr. Jacob, who took over charge of the office of Director on November 6th, 1918, has shown exceptional ability and zeal. The interesting attempt to utilise aeroplane photographs for rapid crop surveys illustrates his readiness to make use of new opportunities. A trained mathematician, and an exact thinker, he has qualities which should be of great value to the Department over which he presides.

16. A weak point in the Agricultural Department is the unevenness with which its energies are distributed over the Province. This is partly due to the paucity of staff and partly to the great concentration of power on the canal colonies in which the Agricultural College is situated. The impending establishment of new experimental farms—for wheat in the north Punjab, for rice in the single harvest irrigation of the Upper Chenab, and (it is hoped) for sugar in the south-east, and for combined canal and well cultivation in the south-west—and the increase in the number of Deputy Directors' Circles from three to six, recommended by the Cotton Committee and endorsed by a recent Provincial Conference, will go some way to set this right.

17. The Financial Commissioner recently saw a note, written in 1887 by a Punjab Deputy Commissioner who advocated the establishment of a Central Agricultural College, the establishment of agricultural schools with nature study and object lessons, the establishment of local committees to deal with agriculture, and demonstration and propaganda work in agricultural methods. A cynical commentator has recorded his despair in the margin of the note. He does not believe that Government will ever bestir itself to do anything or to allow any one else to do anything, he does not believe that the people will understand or pay attention to the propaganda, and he refers to official instruction in improved agricultural methods with a sarcastic citation of the proverbial juvenile who gave instruction in the sucking of eggs.

18. If the cynical commentator could return to the Punjab now, he would find a Central Agricultural College with its instruction so greatly in demand that four-fifths of the applicants have to be turned away, classes for the instruction of school teachers in agriculture with the prospect of the early establishment of agricultural instruction in schools, flourishing agricultural associations in many districts taking a live interest in ~~their~~ subject, and an Agricultural Department which has demonstrably added many lakhs of rupees in a single agricultural year to the pockets of the growers of wheat and cotton, and many tons of food and material to the stores of a hungry world. The cynic, with his wisdom, was wrong, and the hopeful and ingenious Deputy Commissioner—thirty years ahead of his time—was right.

19. The turning point came when it was decided to set up a department of agricultural experts, instead of continuing to rely upon the efforts of the district officer in odd moments snatched from more urgent routine. But it is because the experts have known how to work with one another and with the public, and to make of their knowledge a servant, not a master, that they have won for their department the reputation which it now deservedly enjoys for solid achievement and future promise.

20. Part II of the report has not yet reached the Financial Commissioner.

PART I.

Annual Report
ON THE
Department of Agriculture,
Punjab,
For the year ending June 30th, 1919.

1. The present report, in accordance with the orders of Government conveyed in Revenue Secretary's letter No. 16198-Rev., dated 21st June 1919, differs somewhat from previous reports in being divided into two parts, the first part containing the Report of the Director, and the non-technical summaries of their work written by the Agricultural Experts, and the second part (the Annual Experiment Record) consisting of the technical discussion and data of the experimental work of the year. The district work of Deputy Directors falls naturally into Part I, while their work on the experimental farms comes under Part II. The length of Part I is limited to 20 pages. No limit is fixed for Part II, and it is hoped that in future all data relevant to a full scientific appreciation of the results may be given. To give only one example, in all varietal tests the outturns are affected by or correlated with the dates of sowing, germination, tillering, percentage stand, cultivation, flowering and so forth, all of which factors should be stated, if the tests are to be accepted as authoritative by experts outside the Province. Even within the Province it is sometimes felt that the recorded yields do not form a basis for a judgment of the comparative merits as yielders of two types of a crop, for want of information on some of the causes which determine productivity. The Annual Experiment Record will offer scope for more systematic discussion of inherent or accidental factors influencing yield. Full advantage could not be taken this year of the opportunities which Part II affords in this direction, as the orders of Government only reached some of the Agricultural officers after they had completed their reports on the old ones.

2. Mr. E. A. A. Joseph was Director for the first four months of the year. On the 6th November 1918 I took over the charge from Mr. Joseph.

Mr. Roberts was on leave from 9th January 1919 to 8th April 1919 during which time Mr. Wilsdon officiated as Principal, and Mr. Faulkner carried on the duties of Professor of Agriculture.

Mr. Faulkner is on six months' combined leave from the afternoon of 5th April 1919. Malik Sultan Ali, I.A.S., who has been appointed in the place of Mr. Southern joined on 2nd September 1918, but was put under training at Lyallpur, and is doing the work of Mr. Faulkner.

Mr. Miller Brownlie was on leave from 20th July 1918 to 8th October 1918, his routine duties being carried on by Mr. Faulkner, Muhammad Abdulla, well supervisor, doing the teaching work under the instructions of Mr. Astbury. Maulvi Fatehuddin continued to run the Gurdaspur Circle except for six weeks when he was on leave, during which period Lala Raghunandan Parshad, Honorary Extra Assistant Director of Agriculture, officiated for him. The Hansi Farm remained under the charge of Sardar Darshan Singh, I.A.S.

One new Extra Assistant Director and two extra agricultural assistants were sanctioned for bara reclamation work, while two posts of agricultural assistants have been converted into gazetted rank on Rs. 150—10—300 as Assistants.

to the Economic Botanist and the Agricultural Chemist, respectively. Fifteen new posts were added to the cadre of agricultural assistants. Mr. M Afzal Hussain has been appointed recently as Entomologist on probation for one year and is due to join the college immediately.

3. The Report of the Principal will be found in Appendix I of this Report. There is a steady increase in the number of applications for admission to the college. There was a decrease in the applications of students of the non-agricultural classes, which was more than compensated for by the additional applications from agriculturists. The figures for the last three years are as follows:—

YEAR.	APPLICANTS.			ADMISSIONS.		
	Agriculturists.	Non-Agriculturists.	Total.	Agriculturists.	Non-Agriculturists.	Total.
1917 ...	78	124	202	23	16	39
1918 ...	100	125	225	37	17	54
1919 ...	173	92	265	47	9	56

Thus for the first time this year the applications from agriculturists exceeded in number those from other applicants, though the ratio is still far below the ratio of these classes in the general population of the Punjab. The desirable proportion of about 80 per cent. is attained in admissions. The educational standard of applicants is mostly that of the Matriculation, though those admitted in 1919 include several F.As. and F.Scs. and one B.A. from Sindh. There is also a B.A. from Kapurthala working in the second year. Owing to the April disturbances the External Examiners for the Diploma Examination could not be got together at Lyallpur, and the Chemical Examiner did not turn up at all. Mr. Hector and Mr. Chawla reported fairly favourably on the examination work in Economic Botany and Mathematics respectively, while Mr. Knight had nothing to add to his 1917 remarks in which he praised the teaching of practical agriculture.

The Vernacular Course at Lyallpur admitted 32 students in October 1918, and the Rural Economy Class for Revenue and Irrigation officers which was in abeyance in 1917-18, reopened with 13 students, of whom five were Extra Assistant Commissioners. A short Farmers' Course of about 10 days duration, in which the main subject of instruction was the handling of the implements turned out at the farm, was also held. The teachers selected by the Director of Public Instruction, who are to teach agriculture in selected middle schools, all passed their examination, and were said to be a keen set of men.

The variety of courses at the college is a serious strain on the teaching staff, which but for the affiliation of the college to the University and the more definite standard for the agricultural degree thereby set up, might have led to a loss of efficiency in teaching the students who take the 4-year course, who must form the true nucleus of the college.

An increase of staff must be provided for, partly because the present staff is insufficient for the number of students 50—55 admitted annually, but also because an increase in the number of admissions must be contemplated. Proposals for additional staff were considered at a conference in June last, and separate recommendations will be made shortly to Government. I may note here, however, the opinion of Mr. A. J. Perkins, Director of Agriculture, in a recent address before the University of Adelaide, who said "hence it may be stated very definitely that no single college can pretend to offer adequate arrangements for farm manual training whose average enrolment exceeds 99 to 100 students in any one year: and even this number would prove difficult to handle in any one year." In the Punjab a limit of 90 students will probably be a right one to work to, and this would give about 300 students in residence at one time, or more than double the present number. In anticipation of an increase of staff a revised estimate of Rs. 1,83,000 for the

extension of the chemical block to accommodate the Soil Physicist, the Bacteriologist and the second Agricultural Chemist has been sent up for administrative sanction. An addition of one, or possibly two, entirely new wings for the second Economic Botanist, the Professor of Rural Economics, and for the Entomologist is being considered.

A 9" diameter tube well designed to discharge three cusecs at a cost of Rs. 38,000 has been sanctioned. This will give the college an independent water supply, and also help the Economic Botanist to tide over critical periods of short canal supply. A proposal to notify for acquisition 273 acres of land, most of which lies between the present farm area and the Sarangwala Distributary, has been sent to Government. The present area of the whole college estate is 614 acres.

Twenty-five scholarships of the annual value of Rs. 4,362 were awarded to the students taking the English Course. It is important to encourage students to take the full 4-year's course, and I have sent up a scheme to increase the number of internal scholarships held during the third and fourth years, somewhat reducing the number of entrance scholarships. I have also proposed the award of a scholarship of £250 per annum for two years tenable at a foreign university on the lines of the State Technical Scholarships. A gold medal for the best all-round student called the "Sir Michael O'Dwyer Medal" has been awarded by Khan Bahadur Abdul Ghafur Khan, Sessions Judge of Lyallpur.

There is a fair interest in athletics at the college, but talent does not appear to be much developed. The new Drill Havildar is getting a useful leavening of Military discipline.

The college safely weathered the disturbances of April last, none of the students being implicated in any of the disorders. For this great credit is due to the firmness and *sang froid* of the Principal, Mr. Roberts and of Mr. Milne, both of whom carried on their work as though nothing were the matter. Both of them acknowledge—and I do so too—the beneficial influence of Lala Jai Chand, the Hostel Superintendent, in controlling excitement.

RESEARCH.

4. For the Agricultural Chemist's general lines of work see Appendix II.

Chemical Research.

Technical details will be found in the Annual Experiment Record.

The Narwala Farm of 130 acres which was reclaimed by the late Mr. Barnes and handed back to the owners after three years work on the 1st March 1917 is showing signs of relapse, reh having reappeared in rather over two acres of land. However so far the salts are not sufficiently concentrated to reduce the outturn of wheat, which was 16 maunds average for Rabi 1919, against 13 maunds in 1918, and 18 maunds in 1917. Mr. Wilsdon considers that the success of the experiment was due to the washing down of salts into the sub-soil, lateral drainage being obstructed by the collapse of the mole drains. If this is so the reappearance of the salts on the surface is possibly only a matter of time unless the zamindars are allowed water in something like the quantities put on by Mr. Barnes, and that was over 20' in three years. It will be interesting to see whether deterioration will continue if only a normal water-supply is given to the land.

In Part II will be found admirable reports by Mr. Wilsdon, on the bara reclamation work, on green-manuring, on nitrogen fixation and the sullage experiments. Unfortunately the papers only reached me as the Report was going to Press, and I have not been able to give them the consideration they merit.

The most important initial discovery in the bara reclamation experiment is the fact made apparent in Diagram 1, that in mechanical composition the bara soils do not differ appreciably from bari and kalrathi or even loams, and the deduction is made that the addition of hillock sand or canal silt will not improve bara soil. In fact it would seem that the addition of a soil with a considerable percentage of clay would make the bara soils somewhat

closer in mechanical composition to normal ones, at least in the first three feet. It is the high sodium carbonate content and the low percentage of soluble salts that appear to keep the clay in a colloidal condition and induce the impermeability of bara soils. If this impermeability can be overcome then it may, as Mr. Wilsdon shows, be possible to wash the bara soils sufficiently to allow of the production of nitrogen by soil bacteria. It is in this fact that the Kahuta experiment differs from, and offers far greater difficulties, than at Narwala, where water percolated readily, and excess salts were easily washed out.

Mr. Wilsdon's experiments on green-manuring are particularly interesting because the extent to which the nitrogen is and produced by guara is the real cause of increased yields of wheat, was checked by adding to a control plot an amount of artificial manures containing the same amount of nitrogen. The depressing effect of artificials applied at a rate of over five or six tons per acre, although these contained no more nitrogen than the double quantity of guara, which in clay soils produced an increased yield of straw, and in sandy soils increased yields of both straw and grain, suggests that the benefits of guara are not due in the main to nitrogen. In these experiments green-manuring has had a far greater effect in sandy than in clay soils; in fact in the latter the addition of guara up to nearly 35 tons per acre reduced the yield of grain. The proportionate increase of the weight of straw is always, as Mr. Wilsdon's diagrams show, greater than that of the grain, except for small additions of guara in sandy soils. The experiment is valuable, but the amount of green manure added, from 12 to over 45 tons per acre, is much larger than would be grown *in situ* and ploughed in.

The late Mr. Barnes' experiments on nitrogen fixation in fallow soils have been continued in Hissar, Ferozepore, Sialkot and other districts, as well as at Lyallpur. Between June and November 1918, Mr. Wilsdon found that the nitrogen content of fallow soils in different parts of the Punjab had more than doubled, in marked contrast to 1917 when there had been an actual decrease. Perhaps this accounts for the surprisingly high yields of the wheat crop of 1919.

The sillage experiments cannot be started till the variation of the fertility of different parts of the land is reduced. The contour diagram of yields shows this variation very clearly.

Mr. Wilsdon's activities include a great deal of work not included in his report, in particular, the experiments on seepage; and in sub-soil moisture not being referred to, and it is clear that Mr. Wilsdon has set himself a high standard of research.

5. The Economic Botanist has written an interesting general report (Appendix III). A fuller discussion and brief tables of yields of cotton are given in Part II. Botanical Research. But the Annual Experiment Record should contain much more detailed information of the factors determining yield than Mr. Milne has vouchsafed in the present instance. Thus the statements of yield of cotton do not even give the dates of sowing or the seed rate.

Much of the land in the new botanical area (square 31) is very sandy, and conformably to past experience American cottons have not done well in it. Thus in the sandy soils of this square 286-F averages 11 maunds 22 seers of seed cotton, 285-F 11 maunds 25 seers, against Roseum 124 with a yield of 15 maunds 13 seers. This result appears to harmonise with those obtained at Sargodha, where the soil is distinctly sandy, and Americans even in such a favourable year as the present one seem less promising than desi cottons. Mr. Milne attributes the comparative failure of Americans on the Sargodha Farm to want of water in the first two months of growth. However this may be, there is a clear need for caution before recommending Punjab American types of cotton for all tracts.

When the soil analyses of the Thal area are obtained and compared with those of the Sargodha Farm, and the sandy lands of the Lyallpur Botanical area, pretty definite conclusions should be possible as to the likelihood of 4-F or 285 thriving in the area to be irrigated by the Sind Sagar Canal. 285-F has however done splendidly on suitable soils, Mr. Milne obtaining a yield of

seed cotton of 21 maunds 10 seers in one field with a ginning percentage of 32. This cotton was valued by Volkart Brothers at 10 per cent. above 4-F, and by the Cotton Contracts Board at Rs. 30 per candy above 280-F. The British Cotton Growing Association value 285 at 4d a lb. above American middlings. 285-F will be given extended trials by the Agricultural section at Lyallpur, but Messrs. Roberts and Faulkner have decided to drop 280-F which they find gives one maund per acre less than 4-F, and has too a lower 'Kan'. I saw some splendid 285-F grown by zamindars in Chak 232, Rakh Branch, and they were satisfied that it was a better cotton than 4-F.

The full discussion of the results of field trials, though it is the basic problem in the introduction of improved types, would lead us far from the ordinary subject matter of the Annual Report. Further notes will be found in paragraph 21 dealing with Experimental errors.

It is interesting to observe that Captain Roger Thomas in trials of various types of cotton near Baghdad placed 4-F and 285 third and fourth respectively in yield out of the many varieties tried. He is however making no further trials of cottons 280 or 285. Eleven varieties of directly imported cottons were tried, but like similar previous importations all failed.

In regard to wheats, Mr. Milne has carried through a painstaking preliminary investigation into the milling and baking qualities of seven types of Punjab wheats, of Pusa 12 and one mixed sample in use at the Delhi Flour Mills. A full description of the tests and the results obtained are given in the Annual Experiment Record; but the following analysis showing the weight of bread obtained for 100 lbs. of each type of wheat, is not given explicitly, and is useful in indicating the relative value of wheats from a baker's point of view:—

Type of wheat.	Weight of 100 lbs. of wheat plus conditioning moisture.	Percentage of flour.	Weight of loaves for 100 lbs. of flour.	Weight of loaves per 100 lbs. of wheat.
8-B	105.6	75	144.8	114
8-A	105.4	75	142.9	113
9-C	110.4	72	140.5	112
Punjab 17	104.8	73	141.3	108
17-B	105.6	70	143.5	106
Punjab 11	108.6	70	144.2	105
Punjab 14	105.5	69	137.9	100
Pusa 12 (first lot)	105.6	69	136.8	100
Pusa 12 (second lot)	103.0	69	136.7	97

These tests were made on samples of 1918 wheats, and do not agree, perhaps because they are not exactly *in pari materia*, with the tests made by Mr. Humphreys on 1917 wheats. Mr. Humphreys' order of merit was 8-B, Pusa 12, Punjab 17, Punjab 11 and 8-A. Mr. Milne's tests did not include actual measurement of the percentage of straight-run flour, and arrangements have been made to make this measurement accurately at the Shahdara Mills in September with 500 maunds of each type of wheat. Nor is Mr. Milne satisfied with the baking tests, and the results given above are not therefore to be regarded as final.

Scotch potatoes continue to do well in the Simla Hills, and many enquiries for seed are received from growers elsewhere. At Fagu the growers wish to give up interstripping with desi varieties as they say it leads to a loss of yield. But interstripping is useful 'lest they forget.'

The date palm plantations at Taleri Bagh, Muzaffargarh, is doing well, and Arabian dates of the Halawi and Khudrawi varieties are excellent. A tube well is to be started for the plantation.

Mr. Milne's book on "The Date Palm and its Cultivation in the Punjab" was published in December last, and two leaflets, one on ear-cockle in wheat and one on red-rot in sugarcane are now in the Press.

It will be seen, therefore, that Mr. Milne's multifarious spheres of activity in botanical research are enough, when combined with the teaching work of the college to overwhelm a man of lesser energy and ability.

6. Five hundred and thirty ounces of silkworm eggs were ordered by Mr. Joseph on 18th June 1918. Owing mainly to shipping difficulties the seed which was delivered at Marseilles in the beginning of September, only left that port in November and reached Simla on January 2nd, 1919. The seed was kept at Simla as long as possible for hibernation, but had to be sent down to Lyallpur in the middle of February for distribution to rearers. What with the effect of change of temperature on the long voyage and the short period of hibernation, hatchings were only from 15 to 20 per cent.

Four hundred and seventy-one ounces of eggs were distributed by the department in the districts of Gurdaspur, Ambala, Sialkot and Hoshiarpur besides the 400 ounces distributed by Sheikh Ghulam Sadiq to his rearers in the Gurdaspur District. Fifty ounces were given to the Salvation Army who had asked us to indent this amount for them. The crop has been poor throughout the Province. Possibly on account of short supply very high prices have been offered for the small amount of cocoons so far sold, viz., Rs. 190 to Rs. 200 a maund, as compared with Rs. 120 to Rs. 140 a maund realised last year. This fact coupled with the appointment of a whole-time Entomologist, who will be able to devote more time to sericulture than has been possible heretofore, will, it is hoped, place on a sound footing the silkworm industry which has received a great set-back on account of this year's failure. To avoid a recurrence of this year's mishap I have stipulated that the seed ordered for next year must reach here by the end of October 1919. The Salvation Army has not been very active in the spread of sericulture during the year under report; Simla Silk School has seemingly closed down this year and the past two years' record has not been very satisfactory, and I have therefore not recommended the continuance of the grant-in-aid of Rs. 2,000 a year which was originally sanctioned for three years only.

Sericulture will henceforth become the subject of the Entomologist. It is right to mention that credit is due to Lala Madan Mohan Lal who has carried on the work for the last 10 years with keen personal interest and tact.

Both in the Lower Chenab Colony and on the Lyallpur Farm boll-worm attacked desis more than American cottons. Parasite boxes were distributed in several districts. Mango trees in the Shalamar Gardens were protected from monophlebus bugs by oil and cotton banding, while good work was done in destroying euphalerus citri at Sargodha and Gujranwala with crude oil emulsion and decoction of tobacco.

I may mention on paper—even though I must suppress in practice—my satisfaction that no remedy has been found to protect from the ravages of beetles that detestable vegetable the brinjal.

7. *Well boring*.—There has been a slight increase in the number of wells bored during the year, viz., 340, as compared with the number bored last year, viz., 327, and the percentage of success has risen from 74.4 to 77.6. This is a good record when it is considered that during the year under report two well borers and two mates together with their boring equipment were sent to Persia at the commencement of the year, and the influenza epidemic, stoppage of goods traffic and continued difficulty in obtaining material combined with high prices militated against success. The pay of well supervisors has been revised and steps are being taken to replace the plant sent to Bushire which the Military

Sericulture and Entomology.

Agricultural Engineering.

Works Department are paying for at 20 per cent. above the price at which the machinery was originally purchased.

Tube wells.—Work under this head had practically to stand still owing to two trained mechanic borers (out of a total of three) having been sent to Persia with three sets of heavy plant. The tube well at Chak Hiraj has been completed and work is proceeding at the Jalalabad Installation in the Mamdot Estate.

The tube well for the college has been mentioned elsewhere.

Mr. Miller Brownlie's cultivator fine adjustable without the use of bolts or nuts seems to be of a practical type. He has ingeniously adopted a linkage to produce a parallel, equisecting fine cultivator, the distance between the furrows being easily altered by raising and slipping along a clamp with a positive engagement.

A Gibbs' module of $1\frac{1}{2}$ cusecs was tested at Lyallpur, by discharging it into a sump, by Messrs. Miller Brownlie and Faulkner and the results were communicated to the Chief Engineer, Irrigation. With a free fall for heads of 10" to 16" the discharge was constant at 1.55 cusecs. With a partially submerged orifice, however, the discharge varied from .98 to 1.59 cusecs.

Mr. Miller Brownlie refers to his investigations on the flow of sub-soil water when the equilibrium of the water table is disturbed by a depression caused by pumping. No hydrodynamical solution of this problem has been obtained; but the problem is so important practically that an approximate hydraulic solution would be acceptable, if it is based on a theory of the motion of underground water, found to be nearly true in practice.

8. The Ninth Annual Poultry Show was held at Lahore in December, and in the opinion of Colonel Tyrrell, R. F. A., Poultry and Olives. Honorary Secretary, Indian Poultry Club, the birds were of a better class than usual. The Simla Poultry Show which has been in abeyance since 1913 will be held again in October under the auspices of the All-India Poultry Club. The Deputy Director, Gurdaspur, has purchased a few Rhode Island Reds and some Aylesbury ducks as a beginning.

The Annual Report of the Deputy Conservator of Forests, Rawalpindi West Division, for 1918-19 shows that at the Khairimurat olive plantation 17 maunds of green olives were collected from some 300 trees. This was a great advance on the two or three maunds which the plantation had previously yielded. The fruit, however, was small owing to the prolonged drought.

EXPERIMENTAL FARMS.

9. The data from many different experiments, together with brief notes on them by Mr. Roberts, are given in Part II. Lyallpur Experimental Farm. For the first time in the last four years Punjab 11 gives a greater yield than 8-A. The results from 18 plots of each type in the New Area are—

	Mds.	Srs.
Punjab 11	... 25	37
8-A	... 24	14
8-B	... 20	18

On the tenants' area Punjab 11 gave one maund three seers per acre more than 8-A. I record, without accepting Mr. Milne's opinion, that these results are of less value than those obtained on square 26 (*vide* Statement 34 (a) Part II), where 8-A with 20 per cent. less stand owing to attack by white ants had a yield of 18 maunds 18 seers (average of two plots) against 18 maunds 33 seers of Punjab 11.

The water saving experiments on wheat show a balance in favour of three waterings against two waterings, though the margin is small for early sown wheat. The results confirm and extend those obtained at Sargodha. There were $1\frac{1}{2}$ inches of rainfall in January and February which naturally tended to

-equalise yields from the two series of experiments. When the Irrigation Experiment Station comes into being the determination of the optimum amount of canal water will be one of the chief objects of research.

Mr. Roberts notes on the excellence of 285-F., but considers that it is likely to prove a lower yielder than 4-F.

10. Details of the work of the year will be found in Part II. Cane and wheat are the two most important crops which are tested on the farm. Of the former Behar and Juba with 3,656 and 2,872 lbs. of gur, respectively, stood first and second. A power-driven cane-crusher by the American Plow Company has just been installed, and a new boiler for cane juice is being erected by Mr. Miller Brownlie. There have been several enquiries as to suitable types of such machinery, and with the experience gained from the above we may be in a position to advise.

Among chahi wheats 8-B stood first, but 8-A which is next, would, Maulvi Fateh-ud-Din thinks, have stood first but for lodging. Pusa 12 which is rather low down in the varietal tests also suffered from lodging. 8-A is said to have done well on barani lands. One of Mr. Howard's crosses N. H₉₈ × P₄ gave on an area of about one-tenth of an acre the remarkable yield of 45 maunds per acre. This wheat deserves, and will get, extended field trials. Cultivation and manurial experiments have been continued. The benefits of deep ploughing, especially with the Sabul plough, appear to be marked. Superphosphate added at the rate of half cwt. per acre increased the yield of unirrigated wheats. Well-irrigated wheat did not benefit appreciably from any kind of manure.

11. The area of the farm is 5½ squares, of which four squares are cultivated by tenants for the growth of selected seed. In the rabi of 1918-19, 8-A proved to be the best early sown (25th October) wheat and Pusa 12 the best late sown (29th November). 9-C, whose excellent milling and baking qualities have been noted in paragraph 5 was the third best yielder among the early sown wheats.

Among cottons desi varieties beat the three American types 4 F., 280 and 285 by handsome margins, Mollisoni leading with 1,230 lbs. per acre of seed cotton and 285-F being last with 440 lbs. The relative placing of 280, 4-F and 285 in the order named is contrary to experience with these cottons at Lyallpur. I had the advantage of visiting the farm this year in company with Mr. Milne when the cottons were just beginning to flower, and the stand of Americans was so much below that of desis, that it seems likely that desis will repeat their 1917 and 1918 success. Mr. Milne's views have been briefly referred to in paragraph 5 above. So far none of the desi types grown on the farm have been given out to zamindars in the Lower Jhelum Colony. The advisability of doing so will be considered.

Water saving experiments with Pusa 12 wheat on the lines laid down by Mr. Howard were carried out. But the figures given in Statements VI and VII of the Sargodha Farm Report do not appear to bear out that as far as the experiments go water can be saved without detriment to the yield. Both after chari and after cotton, wheat did better with two waterings than with one watering, and with one watering than with none. The rainfall of 0.28" in December and 0.89" in January, though small, tended to equalise the yields. All plots were harrowed and hoed at the same time.

Both the Gurdaspur and Sargodha Experimental Farms are under the Deputy Director M. Fateh-ud-Din. He has a great deal of district work and it is doubtful whether he has time for that full supervision of the farm work which is necessary.

12. The Deputy Director, Sardar Darshan Singh, was in charge throughout the year. The farm was started in April 1914, and is now in its fifth year. To Sardar Darshan Singh is due the credit of getting it into working order. One of the main

objects of the farm was to develop barani cultivation, but the rainfall of the tract is too capricious for constant cultivation under barani conditions. The year under report was an example of this, as, excluding August 1918 in which 8·3" fell, there were only 3" of rain in the whole of the year. Varietal tests of wheat with three waterings showed 8-A, Punjab 11 and 9-C better than the standard wheat Punjab 14. 8 A was well ahead of the others with a yield of 35 maunds 18 seers of grain per acre.

Among desi cottons white-flowered Neglectum, Bhatla selection proved the best yielder, and had a ginning percentage of 36. Experiments in conserving water by hoeing showed that white-flowered Neglectum did best with four waterings and two hoeings, whereas white-flowered Indicum was best with three waterings and three hoeings. In the varietal tests of cottons, however, five waterings and four hoeings were given. No wheat or cotton could be grown on the barani area. Nor have any drought-resisting grasses, such as were hoped for when the farm was established, been yet brought to light.

Sardar Darshan Singh has devoted much care to evolving a 5-row drill. When I examined the drill last winter I found it was giving a seed rate of over two maunds per acre. Since then I understand this defect has been eradicated. Further information on the experiments will be found in Part II.

DISTRICT WORK.

13. The following statement of sales of imported implements covers the whole of the war period, and shows how the set back started in 1917-18 has become still more pronounced this year, with the rise in prices.

Implements sold in.

Name of implement.	1914-15.	1915-16.	1916-17.	1917-18.	1918-19.
Raja plough ...	188	202	379	63	123
Meston plough ...	664	906	1,264	557	153
Other ploughs ...	16	79	92	41	9
Hoes ...	12	13	10	10	13
Harrows ...	35	55	56	30	12
Fodder-cutters ...	60	58	42	11	80
Miscellaneous ...	...	10	20	13	6
Total ...	975	1,323	1,863	725	396

The following implements manufactured by the Department were sold in addition :—

Name of implement.	Lyallpur.	Gurdaspur.	Hansi.
Bar harrows ...	293	37	...
Drills ...	100	6	19
Lyallpur hoes ...	86	10	...
Miscellaneous ...	189	...	38
Total ...	668	53	57

But for the increased price of agricultural implements there seems little doubt that by now they would have been selling in thousands. Raja ploughs cost Rs. 50 each, Reapers are Rs. 40. Planet Junior hoes stand at Rs. 66-8-0. Bar harrows are very popular, as they well might be as they are sold at Rs. 10, whereas the raw material of which they are made alone costs Rs. 12. We shall raise the price of these to at least the cost of material so soon as they are well established as it would be wrong to under-sell the private manufacturer. The Deputy Director, Gurdaspur, notes that the Meston plough in his circle is now made by the village lohar.

14. The estimates of the area sown with 4-F American cotton in the colonies are only approximations, but the estimators, particularly Mr. Roberts, are so closely in touch with agricultural conditions there that the figures are probably fairly close. Compared with last year the sowings are—

		1918.	1919.
Lower Chenab Colony	... ..	190,000	200,000
Lower Jhelum Colony	... ..	16,000	60,000
Lower Bari Doab Colony	... ..	173,000	235,000
Chunian Colony	... ..	10,000	10,000
Upper Jhelum Colony	... ..	1,000	6,600
Total	... ..	390,000	511,000

The increase in the Jhelum and the Lower Bari Doab colonies is particularly marked.

A proposal has been made in the Bombay Market to make Punjab American tenderable against a Broach contract, and the Department has been asked to prepare three standards of superfine, fully good and good American cotton. The fixing of standards is one of the recommendations of the Cotton Committee, and will I hope enable the zamindar to get his proper premium for Punjab American.

The advantage of sowing cotton in lines is beginning to be appreciated particularly in the Lower Bari Doab Colony. I cannot however share the opinion of one Deputy Director who considers that the encouragement of better cultivation is more important than the introduction of new types of seed. Effort should be directed to both these ends. This may be obvious; but when one remembers the violent partisanship which rules in scientific controversy on this very question of Nature *versus* Nurture, it is well to emphasize dissociation from any particular theory of the relative effects of heredity and environment.

15. Punjab 11 continues to be the most popular wheat in the Canal Colonies. It is the wheat which constituted some 80 per cent. of the varieties existing in the colony before the work of the Department began to take effect. The increase in yield obtained from pure Punjab 11 on a given area has to be calculated on the difference of yield of Punjab 11 and the mixed types previously prevalent on one-fifth of the area on which Punjab 11 is now sown, and not on the whole area. The figures of area under Punjab 11 in 1918-19 compared with the 1916-17 and 1917-18 sowings are :—

		1916-17.	1917-18.	1918-19.
Lower Chenab Canal	... ..	60,000	100,000	150,000
Lower Jhelum Canal	... ..	22,000	45,000	50,000
Lower Bari Doab Canal	... ..	15,000	50,000	100,000
Upper Chenab Canal	... ..	Nil	1,500	2,500
Total	... ..	97,000	196,500	302,500

Assuming roughly that Punjab 11 gives one maund per acre more than the mixed varieties it has replaced, the 1918-19 colony crop was 60,000 maunds more than it would have been without the distribution of pure Punjab 11.

16. In all 12 auctions of Punjab American cotton were held under the ægis of the Agricultural Department and three under that of the Co-operative Credit Societies, in all 122,000 maunds of cotton being sold at prices varying from Rs. 17-5-0 per maund at Okara on the 2nd December 1918 to Rs. 24-12-0 at Sillanwali on the 23rd December 1918.

Details are given below :—

Cotton Auctions.
(By the Agricultural Department.)

1	2	3		4		5		6		7		8	9
Place.	Date.	QUALITY A.		QUALITY B.		QUALITY C.		QUALITY D.		QUALITY E.		Total sales.	Chief buyers.
		Weight in maunds.	Price per maund.	Weight in maunds.	Price per maund.	Weight in maunds.	Price per maund.	Weight in maunds.	Price per maund.	Weight in maunds.	Price per maund.		
Montgomery	28th November 1918	9,190	Rs. A. P. 20 1 0	590	Rs. A. P. 18 8 0	...	Rs. A. P. ...	...	Rs. ...	...	Rs. ...	9,780	Messrs. Tata Sons & Co. Forbes, Campbell & Co. Ralli Bros. Gulzari Mal Ram Chand. Lala Prabh Dayal. Lala Banke Mal. Messrs. Sukhdev Baksh Miltan Chand, and Haji Muhammad Farid, Kasur.
Chichawatni	30th November 1918	14,200	18 4 0	400	17 9 0	300	18 11 0	...	...	...	...	14,900	
Okara	2nd December 1918	7,400	18 1 6	575	17 5 0	...	...	...	...	...	...	7,975	
Gujra	12th December 1918	1,360	19 14 0	1,870	19 8 0	300	19 9 0	...	...	...	...	3,530	
Jaranwala	3rd January 1919	2,880	22 14 0	8,000	22 2 0	2,300	22 2 0	880	23	4,000	22	18,060	
Mianchann	18th January 1919	4,250	20 0 0	...	...	...	...	...	...	...	...	4,250	
Pattoki	22nd January 1919	1,430	21 2 0	275	19 14 0	...	...	...	...	...	...	1,705	
Sargodha, I	16th December 1918	13,508	21 8 0	2,214	21 3 0	461	20 8 0	...	...	...	...	16,133	
Sargodha, II	13th January 1919	814	22 12 0	2,218	22 15 0	627	22 2 0	...	...	...	...	3,659	
Bhalwal	19th December 1918	...	...	645	21 12 0	692	21 8 0	...	...	...	...	1,337	
Sillanwali	23rd December 1918	96	24 8 0	717	24 12 0	284	23 7 0	...	...	...	...	1,097	
Baba-ud-din	21st December 1918	533	21 6 0	965	21 1 0	1,337	20 5 0	...	...	...	...	2,835	
Total		55,661	...	18,469	...	6,301	...	880	...	4,000	...	85,311	

Besides the above, auctions were held by the Co-operative Department as below—

Lyalpur, 1st auction	5th December 1918	...	Rs. 19 to Rs. 20-7-0 a maund.
" 2nd auction	27th January 1919	...	Rs. 19-4-6 to Rs. 22 a maund.
Toba Tek Singh	9th December 1918	...	Rs. 18-3-0 to Rs. 20-3-0 a maund.
		...	37,010

These auctions would, it was hoped, be gradually taken over altogether by the Co-operative Sale Societies, but the Co-operative Department finds at present that it cannot undertake fresh auctions, and the Agricultural Department must therefore continue this important work, so admirably organised by Mr. Roberts.

17. The purchase and sale of good cotton and wheat seed continues to be a very important part of the Department's work. The allotments from Wheat Profits for this purpose were—

			Rs.
Lyallpur (including Montgomery)	...	...	2,60,000
Gurdaspur (including Sargodha)	...	...	75,000
Hansi	...	...	21,000
Total			3,56,000

The statements below show the transactions which took place in the year ending 31st March 1919 for wheat and cotton :—

Name of Depôt.	PURCHASE AND SALE OF WHEAT SEED.				Profit.
	Purchase.	Sale.	Purchase money.	Sale money.	
	Maunds.	Maunds.	Rs.	Rs.	
Lyallpur including Montgomery	24,267	24,057	92,427	1,38,714	46,287
Gurdaspur including Sargodha	6,026	6,026	27,609	36,056	8,447
Hansi	1,087	1,087	5,304	6,709	1,405

Name of Depôt.	PURCHASE AND SALE OF COTTON SEED.				Profit.
	Purchase.	Sale.	Purchase money.	Sale money.	
	Maunds.	Maunds.	Rs.	Rs.	
Lyallpur	28,463	...	...	...	...
Gurdaspur	8,865	1,205	48,671	6,733	...
Hansi	2,149	...	...	...	...
Montgomery	11,713	4,342	...	396	...
Sargodha	...	...	...	...	...

Complete figures not yet available.

18. This was a special measure designed to secure a sufficiency of seed at sowing time at reasonable prices. The harvests of 1917 and 1918 had been comparative failures, the outturns being 59,000 and 43,000 tons against 120,000 tons in 1916, and in 1918 prices of seed went to as much as Rs. 20 a maund at sowing time. Practically all Deputy Commissioners, particularly in the Eastern Punjab, anticipated shortage of seed and high prices, and were prepared to indent for large quantities. I reduced their indents considerably, and at the end of May estimated that some 35,000 maunds of chari seed would be required, exclusive of 10,000 maunds which the Department was helping the Registrar, Co-operative Credit Societies, to obtain from Bhopal. At that time the price including freight and other charges in the Punjab of imported chari seed was about Rs. 10 a maund and Government sanctioned an expenditure for the purchase of seed of 3½ lakhs, the greater part of which would, it was hoped, be recouped. In June local prices in Hoshiarpur, Jullundur and Ambala were unsteady at Rs. 12 to Rs. 14 a maund, and judging from last year's experience seemed likely to go higher as soon as the rains came and the sowing demand increased. At first I could get no quotations even from a firm like Ralli Brothers, who made enquiries from all over India for me, which would enable me to resell below Rs. 10 a maund, but eventually I was able to enter into two contracts of

Sale of chari seed.

3,000 maunds each with a bania of Gurdaspur, who was able to import seed from Gwalior, and the firm of Messrs. Tola Ram-Ram Chand, Agents of Messrs. Clements Robson. The seed was to be delivered at the following stations :—

					Maunds.
Hoshiarpur ..	...	...	...	...	1,250
Garhshankar ...	...	...	...	...	1,750
Jullundur	...	...	...	...	1,500
Phillaür	...	...	...	...	1,500
Total				...	6,000

The stipulated dates of arrival at the consignee's stations were the 24th June for Hoshiarpur and Garhshankar consignments, and the 5th July for Jullundur and Phillaür. There was however some delay in delivery. The arrival of Co-operative Societies seed and the anticipated arrival of our own, already began to cause a drop in prices at the beginning of July, and as soon as our seed arrived the mandi traders lowered their prices out of all recognition. The Tahsildar, Jullundur, tried lowering prices of our seed below the Rs. 9 a maund which I had originally fixed, but found himself outbidden every time by the bania. The change in prices is recorded below :—

Place.	Date of arrival of our seed	Price in mid-June.	PRICES IN RUPEES PER MAUND.		Price in mid-August.
			Price when seed arrived.	Price a week later.	
		Rs.	Rs.	Rs.	Rs. A. P.
Hoshiarpur ...	19th July 1919	13	10	5	3 7 0
Jullundur ...	8th July 1919	12	9	4	3 0 0

Thus though only just over 400 maunds of the Department's seed has been sold, one of the objects of import, that of providing cheap seed, has been secured, and an economic experiment has been carried out with results which are most amazing and suggestive. What the full interpretation of the unparalleled drop in prices is cannot be affirmed, and it is quite possible that the bania himself overestimated the demand ; but at the same time it is practically certain that local dealers intended making a profiteering coup on the lines of last year, and were foiled by the action of the Co-operative and Agricultural Departments.

The loss to Government will be about Rs. 25,000 but the benefit to the zamindars has been incomparably greater, and from what I learn from District Officers and others, Government's action has been highly appreciated by the agriculturists of the Eastern Punjab.

19. During the year land has been acquired for a Demonstration Farm at Jullundur, and it has since been taken over on the 9th of August, the initial cost of land and buildings being met from a grant of Rs. 42,500 from Wheat Profits.

Land for demonstration farms has also been notified for acquisition at Ludhiana, Hoshiarpur, Sialkot and Amritsar, while several other District Boards, notably those of Hissar and Shahpur, are anxious to start them. The farm at Amritsar is to be run partly for purposes of demonstration and partly for instructional purposes at the Khalsa College. Altogether a sum of Rs. 2,25,000 has been earmarked by Government from Wheat Profits for initial expenditure on demonstration farms. Of this Rs. 1,54,476 have been allotted by me

so far. The Demonstration Farm at Badiana in the Sialkot District was given up during the year. The construction of the line to Pasrur has so much reduced traffic on the road that taken with Badiana's distance from Sialkot robbed it of any value. When I saw the farm in January, when it was still under our control, the wheat on it was demonstrably inferior to that growing on adjacent land of similar quality cultivated by zamindars. The policy of having demonstration farms has been severely criticised by Mr. Roberts, who points out that in his circle, where the improvement of agriculture has been greater than in any other part of the Punjab, the results have been obtained without such farms. As against this, it must be remembered that research work at Lyallpur has, no doubt rightly, aimed chiefly at discovering crops and methods suited to colony conditions, and that improvements are easier to introduce here than in other parts of the Punjab where tradition is stronger and holdings smaller than in Lyallpur and Montgomery. At the same time there is very great force in Mr. Roberts' contention, and I am clearly of opinion that demonstration must follow and not precede the most careful research in a place with a similar soil and climate to that in which it is proposed to demonstrate the superiority of varieties of crops or methods of cultivation. To attempt to demonstrate to zamindars what has not been clearly established by patient work of the best standard is to court ridicule and weaken confidence.

A useful system, referred to in the last annual report, is that of demonstration plots, used by the Deputy Directors of Hansi and Gurdaspur. No land is acquired, but the zamindar gets his land cultivated under the supervision of an Agricultural Assistant and a mukaddam. These plots have been worked at Bahauddin, and Panipat, in the Hansi circle, and at Shankar, Chuheke, China, Nakodar Bhenimilwan Lakhana, Khana Baharwal, Shahbazpur, Gumtala and Salehpur in the Gurdaspur Circle.

Agricultural Association meetings have been held in the districts of Lyallpur, Montgomery, Gurdaspur, Jullundur, Hoshiarpur, Sialkot, Shahpur and Ferozepore. The presence of members of Co-operative Societies at the meetings gives them a vitality which they would not otherwise possess. At the same time the exclusion from the meetings of all non-co-operators, which Messrs. Calvert and Strickland think so desirable, is not a step which my predecessors and I have thought right to take.

A seed godown for a Co-operative Store society to hold 5,000 maunds has been built at Shakargarh in the Gurdaspur District out of a loan of Rs. 8,000 from Wheat Profits. A proposal to build another small seed godown of 800 maunds at Kala Afghanan from the design of the Agricultural Engineer is being considered. The 7 rectangles of canal irrigated land earmarked for fruit farming at Montgomery have been promised to Ganda Singh Cheema, an M.Sc (Botany) of the Punjab University, who has done some research work on rust in wheats, on condition that he completes a 2-year's course in Horticulture to the satisfaction of the Director. He is now proceeding to Maine University, United States, where instruction in fruit farming is taught in great detail. Ganda Singh will also study the practical and business sides of the fruit industry in California.

The option on the 7,500 acres at Khanewal, which was given to the British Cotton Growing Association, lapsed on 1st September 1918. Mr. Roberts met representatives of the Association when he was in England last spring, but found them, with one or two exceptions, singularly inappreciative of the value of the concession. No doubt the uncertainty of the future of trade was partly responsible for this attitude, but one cannot help feeling that British cotton buyers may sooner or later greatly regret the lost opportunity.

MISCELLANEOUS.

20. Proposals to complete the elevator by putting in the machinery, purchasing engines and motors, and building offices and quarters at a cost of Rs. 1,40,000 have been sanctioned. As there is little immediate hope of getting electricity from a Municipal Supply Company, three 40 H. P. Ruston Procter oil engines have been bought in India, and motors have been ordered from England. It is possible, but by no means certain, that the elevator will be ready in

The Lyallpur Elevator.

May next to receive the 1920 wheat crop. Even if it is not, if 100,000 maunds of wheat are kept in the Elevator at Government account from October onwards this is bound to have some small steadying effect on winter prices. Negotiations are in progress for the running of the business by a well-established firm of grain dealers. The possibility of running the Elevator co-operatively has not been overlooked.

So far there are no waggons on the North-Western Railway which are adapted to the bulk handling of wheat, but this will not delay using the Elevator for export purposes, as off-loading in bags is being arranged for. Nor do facilities for bulk handling exist at present at Karachi, but I found on a recent visit there that Mr. (now Sir Horace) Mules, Chairman of the Karachi Port Trust, fully realised that the provision of Terminal Elevators was likely to be necessary before long. Many of the exporting firms, too, appreciate the advantages, though they point out certain disadvantages from their point of view, of an Elevator system. I have made proposals for a consideration of the general scheme of Elevators for the Punjab.

21. The problem of the standard errors of field trials which is of the utmost importance in deciding whether differences of yield in varietal tests are significant or not, has been carefully studied by Mr. Faulkner, and the results obtained by him are being considered. In 1917 I examined the data of the Lyallpur Farm of the relative yields of Pusa 12 and Punjab 11 in 1914-15 and 1915-16, and found a decisive probability (15 to 1) in the conditions obtaining at Lyallpur in those two years, in favour of the latter wheat being the better yielder. The superiority of 4-F over 280-F, tested for the 1918-19 yields, brings out odds of 32 to 1 in favour of the former, while for the five years 1914-15 to 1918-19 the odds in favour of 4-F are 16 to 1, the margin being a little over a maund per acre. Mr. Roberts' decision to give up further trials of 280-F is thus fully justified. I hope to examine all available data of the relative yields of 8-A and Punjab 11 wheats, the former, after holding the advantage for three years, having been outstripped by Punjab 11 at Lyallpur in 1918-19. Rai Sewak Ram tells me that at Gangapur he found exactly the same thing, so that the farm results are confirmed. This reversal of form emphasizes the necessity for avoiding hasty expression of opinions on the merits of different types of crop and the importance of analysing the data of yields by the methods of statistical probability. Further work in the interpretation of field trials will be carried on when Mr. Faulkner returns.

22. Government has sanctioned for a period of six months a staff of one Naib Tahsildar and three computers to enable me to carry on my work on the correlations of areas and yields of crops with rainfall, prices and so forth. The computers have worked well, but unfortunately the Naib Tahsildar, though he was a fairly capable man, and had done good work in collecting statistics for Mr. deMontmorency on the Upper Bari Doab Canal, was struck off the roll of Naib Tahsildar candidates by the Commissioner, and the blow rendered him useless. The terms I could offer prevented my obtaining a good man to replace him. A much stronger staff for the collection of statistics will be asked for. The mere routine analysis of economic data, however, is a snare and a delusion unless the fullest thought is brought to bear on the problem. The road to truth can never be macadamised.

The whole work of issuing official crop forecasts has been taken over from the Director of Land Records. This work is for the present continued on the old lines and the forecasts depend very much on the District officers' estimates of area. For yields, however, particularly for the wheat and cotton forecasts, much reliance is placed on the estimates of Agricultural officers, trade experts and big zamindars.

23. The possibility of utilising photographs taken from aeroplanes for purposes of rapid crop surveys was considered by Captain H. H. Thomas, who was in charge of the aeroplane photography of the Egyptian Expeditionary Force, and myself, last winter. With the permission of Brigadier-General MacEwan, Director-General of Aeronautics, a series of photographs of an area under crops in village

Makmanah, five miles south of Lahore Aerodrome, were taken by pilots of the 52nd, Wing, R. A. F., from heights varying from 3,000 to 13,000 feet. The camera available was admittedly not of the best type and even at 13,000 feet all detail of the crops were lost. In fact even at much lower altitudes the definition in the photographs was far inferior to that obtained by Captain Thomas in Egypt at heights of 17,000 feet. Even so a crop like sugarcane is perfectly distinguishable at 10,500 feet. At this height senji and wheat are often similar in shading, but a field of senji could frequently be differentiated by irregular patches where the crop had been cut for fodder. Gram was too thin and struggling to be very different from a field of fallow.

The next step is to get photographs taken with better cameras, and to experiment with screens which will accentuate the tints. Better cameras are being obtained from England, and General MacEwan has kindly promised to arrange for a fresh series of photographs to be taken during the early winter and for experiments to be made with various colour screens. Cane, cotton and wheat are then the principal crops. When the bolls are open cotton ought to be distinguishable at any height, cane is distinguishable up to 10,000 feet and might, in a good photograph, be clear up to 17,000. Wheat alone is likely to present difficulties. But I have no doubt they can be overcome. If these crops show marked differences at 17,000 feet, a couple of 100 photographs taken with a 10" lens covering an area of about 800 square miles, allowing 200 miles for over-lap, would give a basis for forecasts of area which could not be surpassed.

24. The Annual Report necessarily emphasizes past achievement at the expense of future tendencies. But while the work of the experts has in the past been highly successful and is deserving of great praise, it is clear that in the future success will depend more on accurate research and less on simple prescriptions than hitherto, and can be obtained only by increasing the superior staff, so that it is not distracted by having to attend to too great a variety of problems nor overburdened with the work of teaching and propaganda. Proposals to this end were considered and accepted with minor changes at a conference of Agricultural, Educational and other officers and non-officials on the 25th June 1919, and will shortly be submitted to Government.

The Department continues to receive great help from a number of officials and others. In addition to those referred to in previous reports I would like to acknowledge the help received from Mr. Richey, Director of Public Instruction, Mr. Roberts of Clements Robson & Co., Major Gwynn, Deputy-Controller of Contracts, Mr. Ball, Manager of the Delhi Flour Mills, and Rai Bahadur Ganga Ram.

S. M. JACOB,

7th September, 1919.

Director of Agriculture, Punjab.

APPENDICES.

APPENDIX I.

Annual Report of the Principal, Punjab Agricultural College, Lyallpur, for the year 1918-19.

I HELD charge of the office of the Principal for the whole session barring January 8th to April 8th when I was on leave and Mr. Wilsdon acted for me.

The main points of interest are as follows :—

- (1) Our F.Sc. students appeared for the first time in the University Examination. Twelve out of sixteen were declared successful, two being in the first class.
- (2) The Syllabus for the B.Sc. has been fixed. It is noteworthy in that only two main subjects are required for the Degree instead of three thus enabling us to aim at a high standard in Agriculture and one Science or in two Sciences only in case of those who ultimately wish to proceed further with Chemistry or Botany. The Courses in Agricultural Science in the leading Colleges of the world were considered before adopting this important step.
- (3) The Teachers' Class started last year was very successful and 20 more men have been enrolled this year and also one teacher from Baluchistan. Experience this year tends to show that care must be taken in the selection of these teachers if full benefit is to be obtained from their services afterwards. The Director of Public Instruction has been addressed in this matter. The College has also undertaken to supervise temporarily the work of the teachers turned out.
- (4) The six students from the Chiefs' College admitted last year have been in residence over a year. Two more have been admitted this year and one from Ajmere. The educational qualifications of these men are somewhat below our average students, but their knowledge of English is generally very good. They have generally worked hard and one or two give promise of attaining a very good position in their class.
- (5) Proposals for extension of the College and strengthening of the staff have gone up to Government, and if sanctioned will enable us to give training at Lyallpur equal to, if not better than, that at any of the first class American or European Colleges. In a technical college where the staff is expected to do Research and District work in addition to teaching the importance of adequately strengthening the superior staff cannot be over-emphasized.

There were 265 applications for admission, as compared to 223 last year. Several applicants have passed the F.A. and F.Sc. and one from Sindh is a B.A.

Fifty-six students have been admitted this year; the number is excessive for present equipment and staff, but as it is hoped to secure improvements in the course of the next two years the largest number possible has been admitted in order to prevent sudden expansion and to provide full work for the increased staff when available.

Vernacular class.—There were 60 applications and 32 were admitted, of whom 9 came from the Co-operative Credit Department. It was hoped to start a similar class at Gurdaspur this year, but for lack of staff nothing has so far been done. As pointed out last year such classes should be held at all Circle Headquarters.

Sindh students.—At the request of the Commissioner in Sindh room was allotted from 1918 for some Sindh students who are expected to derive more benefit at Lyallpur under Irrigation conditions than at Poona where local conditions are so dissimilar to Sindh. Five students from Sindh were admitted this year.

Rural Economy Class.—Thirteen Revenue Officers attended the class during March. A bigger class will be held in the coming spring if possible.

Examinations.—The following table gives details of examinations held and number of students at each examination :—

Class,	Number of students examined.	Number of students passed.	Number who obtained 1st class.
Diploma	4	4	<i>Nil</i>
3rd Year	18	18	5
Leaving Certificate	14	14	1
2nd Year (University Class)	16	12	2
1st Year	44	43	10
Vernacular Class	26	26	<i>Nil</i>
Teachers' Class	20	20	<i>Nil</i>

Scholarships.—These are being awarded as usual.

Proposals for increasing the value of scholarships and increasing the number of internal rather than entrance scholarships have been sent up for sanction by the Director.

Applications for admission.—The following table shows the number of applications for admission from each Division as well as from the Native States, Sindh, Baluchistan, Rajputana and other Provinces of India.

<i>Division.</i>	<i>Number of Applications.</i>
Ambala	24
Jullundur	43
Lahore	61
Multan	46
Rawalpindi	69
North-West Frontier Province	2
Sindh	5
Baluchistan	2
Chiefs' College	2
Native States and other Provinces	10
Rajputana	1
Total	265

The following District Boards have awarded scholarships :—

One each by Shahpur, Hoshiarpur, Ferozepore, Dera Ghazi Khan, Gurdaspur, Jullundur and Kangra, and two each by Hissar, Jhang and Rohtak :

And for Vernacular Class by following District Boards :—

One each by Mianwali Rohtak, Ferozepore, two by Gujrat, and three by Lyallpur.

<i>Endowments.</i>	<i>Yearly.</i>
	Rs.
1. Faridkot	360
2. Rai Bahadur Lala Mohan Lal	144
3. Kapurthala	392
4. Chamba	420
5. Patiala	240
6. Kashmir	960
7. North-West Frontier Province	480
8. Bombay	720
9. Co-operative Credit Societies	549
10. Anjuman Rayan, Lahore	120

My hearty thanks are due to these District Boards and donors for their generous support.

Hostel, Clubs, etc.—The general health of students has been satisfactory, though the arrangements for medical attendance during the influenza epidemic proved very inadequate. It is hoped a resident Dispensary can be provided when we have our new buildings. The number of students of all classes during the past year was 153.

A Drill Instructor was sanctioned by Government during the year and drill is fairly popular with students and tends to help discipline. The recent disturbances passed off very quietly at the College.

W. ROBERTS,

Principal, Punjab Agricultural College, Lyallpur.

APPENDIX II.

Annual Report of the Agricultural Chemist to Government, Punjab,
Lyallpur, for the year ending June 30th, 1919.

Staff.—Bhai Arjan Singh, Research Assistant, was put in charge of the Ganji Bar Experimental Station, Kahuta, Montgomery District, as Manager from 10th August 1918, and was promoted to gazetted rank as Extra Assistant Director, from 1st April 1919. This transfer from the staff of Assistants engaged on Research work in the Laboratory means a loss of one worker, and will necessitate the creation of a new post if the Research work is not to be curtailed.

Bhai Gurdial Singh, B.Sc., was appointed Demonstrator on 1st October 1918 in place of Mr. T. M. Nair resigned.

Lala Ramji Narain was awarded the Degree of D.Sc. of the Punjab University, for a Thesis on the Oxidation of the Sugarcane, and was promoted to gazetted rank as Assistant to the Agricultural Chemist, from 3rd April 1919.

Provincial Work.—A large number of soil analyses amounting to over 600 samples have been completed this year. These would under usual conditions have been dealt with under this head, but as they were undertaken for a special object they will be referred to under other heads. The work undertaken for foreign departments or private individuals amounted to 68 samples as shown below :—

Soils	...	...	...	...	...	14
Manures	...	...	...	...	...	5
Foods and feeding stuffs	...	...	...	...	...	3
Oil-seeds and cake	...	...	...	...	...	3
Sugarcane	...	...	...	...	...	27
Sugar beet	...	...	...	...	...	4
Sands for filter bed	...	...	...	...	...	5
Miscellaneous	...	...	...	...	...	7
Total						68

Research.—1. *Reclamation of barren land in Montgomery District.*—The progress of work at the Ganji Bar Experimental Station is described in the Annual Experiment Record. Reference need only be made here to the Laboratory investigations in connection with this subject. Further Chemical and Physical study of the soils has been proceeded with. The results arrived at confirm the conclusion reached last year that there is no fundamental constitutional difference in composition of abnormal soils when compared with normal cultivated soils situated nearby.

Investigation of the colloidal properties of these soils referred to last year was continued, but had subsequently to be put on one side on account of press of other work. Study of the dye absorption method proved that little or no reliance can be placed on comparisons made in this way until we have a much clearer knowledge of all the factors involved.

The electrical method of investigation is more promising, and it is hoped to continue the work when more staff is available.

2. *Work in connection with Canal Seepage.*—(a) Study of the flow of viscous liquids in porous media was continued. The results obtained were unfortunately found to be affected by a consistent error due to the design of the apparatus. The result so obtained may not be without importance, but the results will need repetition with a freshly designed apparatus.

(b) Study of the movement of soil moisture under field conditions was continued. Four borings were made in such a way that it was possible to estimate the concentration of moisture in every foot or six inches of the soil down to the water level. In order to get comparable results it is then necessary to express the concentration of moisture in terms of the moisture retaining power of the soil. This involves a laborious mechanical analysis, but the work was subsequently shortened by the application of a centrifugal method by which the moisture retaining power or "Moisture Equivalent" may be determined in one operation. The results so obtained are then correlated with the history of the soil under investigation. The results indicate a close connection between the excess moisture held by the subsoil and the amount and time elapsed since previous irrigation or rainfall. The question is, however, so complicated by the action of other variable factors such as evaporation, temperature gradient in the soil, etc., etc., that much work remains to be done before the object of being able to predict the loss of water to the subsoil under all conditions, will be attained. Work on these four borings alone necessitated no less than 350 separate determinations and 2,800 weighings. The experimental error involved in investigation of single borings is very considerable and recently a method has been devised which will allow of more accurate determinations.

3. *Soil surveys*.—During the year a paper on this subject was published in the Agricultural Journal. The importance of the knowledge which may be gained by systematic study of the soil types occurring in the Province has been recognised by Government, and definite proposals for the entertainment of a special staff for this work have been submitted. Meanwhile during the year preliminary study of the methods of work has been in progress. The work has been necessarily of a somewhat tentative character, as it has had to be done by the limited staff I could spare from the other Laboratory work in progress. It is intended to commence work on a detailed survey of the Sind-Sagar Doab as soon as possible so that definite knowledge may be available when the canal project advances to the stages of construction and colonization.

4. *Sugarcane*.—No further work has been done on this subject in the year under report, except chemical control of the manurial and varietal experiments at the Gurdaspur Experimental Station. An account of the results of this work will be found in the report of the Deputy Director in charge.

5. *Oil-seeds*.—The work on selections of Toria, Sarson and Rape has had to be discontinued on account of the fact that the cultural work which is being conducted by Mr. Faulkner has not yet advanced sufficiently to provide the necessary material for chemical investigation.

6. *Green manuring experiments*.—This line of work was started in September 1918, with a view to investigating the relative importance of the Nitrogen and humous factors in this cultural operation. Recent work of the Imperial Agricultural Bacteriologist has rather emphasized the importance of green manuring as a method of enriching the soil in Nitrogen. The results obtained here indicate that the addition of humous, particularly in the case of light soils, plays a preponderating part in increasing the cropping. This is probably mainly due to the improved water retaining power of the soil. The proposal to apply only the Nitrogenous compounds fixed in a leguminous crop by fermenting the cut crop and applying it to the soil in irrigation water cannot be advocated. Detailed accounts of this work will be found in Part II.

7. *Bacteriological work*.—(a) The examination of Nitrogen Fixation during the kharif fallow throughout the Punjab, showed that in most cases little or no Nitrogen was fixed this year, although in some cases as much as 30 per cent. increase was observed. This points to the fact that this important process of the natural recuperation of the soil is governed by a factor or factors of which we are at present ignorant.

(b) Laboratory experiments on the connection which may exist between the Protozoal fauna of the soil and the activity of Nitrogen Fixing Bacteria were commenced. It was discovered that whereas Protozoa were present in abundance during the winter season, during the hot weather and up to the time of the rains these organisms were either entirely absent or present in very small numbers. Cultural experiments in soil media proved however that the amount of Nitrogen fixed by Bacteria was greater in the presence than in the absence of Protozoa. Since Protozoa feed on Bacteria of the Azotobacter type this result is somewhat surprising. The significance of this and other results cannot be fully interpreted until further work has been completed. An elaborate series on these lines has been started this year.

(c) Investigation of the Biological properties of Montgomery soils in connection with reclamation work has been continued. It was found that normal soils as well as abnormal were incapable of nitrifying oil free sarson cake. This result is of interest from the point of view of the use of the method for the examination of the fertility of virgin soils, but will need confirmation and extension.

(d) The work on the influence of food concentration on the rate of nitrification, referred to in last year's report is ready for publication.

8. *Other investigations*.—(a) No systematic work can yet be reported on the experimental sillage plots, as the land is not yet sufficiently evened up for cropping experiments.

(b) The investigation of vegetable rennet has so far failed to produce an extract of sufficient strength for economic employment.

(c) The trials of alumino-ferric for water purification of the Lyallpur Municipal Supply has not given conclusive results, but the work will be continued when certain structural alterations at the Works are complete.

(d) Biological analysis of drinking water showed that the supply was badly contaminated.

B. H. WILSDON,

Agricultural Chemist to Government, Punjab, Lyallpur.

APPENDIX III.

Annual Report of the Economic Botanist to Government, Punjab, Lyallpur,
for the year 1918-19.

Cottons.—Eighteen acres were available for cotton work. We had about 80 types of American and 96 of Desi under trial interstriped as usual. Only about 6 acres of the land was of fair or good quality; the remainder was of the poor sandy lands already often referred to. For effects of these lands see Part II of this report.

As regards outturns on moderately good land on our half-acre plots, the American cotton No. 285-F topped the list. It was grown on four half-acre plots and one of these gave an outturn of kapas of 21 maunds 10 seers per acre. This plot had been manured with city refuse a number of years ago; but the soil of about one third of it is naturally hard and unsuitable for cotton growing. The plants in this hard portion of the plot were undersized, while on the remainder the plants were well grown and bore heavily. On another $\frac{1}{2}$ -acre plot 285-F yielded 15 maunds 21 seers per acre, one-third of the land was again hard and many plants on the other two-thirds were destroyed by root-rot. The remaining two plots yielded 12 maunds, and 11 maunds 9 seers of kapas per acre, respectively. These two plots consisted of light sandy soil.

Many other selections of American cotton gave very promising results when all factors affecting the economic value of the crops produced by them are considered.

Among the Desi selections on the $\frac{1}{2}$ -acre plots Roseum No. 132 gave the highest outturn of kapas. This was 18 maunds 22 seers per acre on the plot alongside the plot of 285-F which gave 21 maunds 10 seers per acre. This plot had been manured along with 285-F plot and was very similar to it, as far as soil and treatment are concerned. A second $\frac{1}{2}$ -acre plot of Roseum No. 132 gave 15 maunds 13 seers per acre. The germination in this case was not regular and about one-fourth of the land had practically no plants on it. The first sowing of a third $\frac{1}{2}$ -acre plot of this variety failed, and as the second sowing was done on 15th June the case cannot be compared with the others. Various other selections of Desi cotton did very well.

Regarding cottons recently imported direct from America see Part II of this report.

Twenty-seven samples of American and 6 of Desi lints were sent to Messrs. Tata & Co., Bombay, for valuation and opinion. On the day of valuation Scind American and Combodia cottons were selling at Rs. 625 and 650 per candy (784 lbs.), respectively, while the highest valued of our types, *i.e.*, 289-F was valued at Rs. 900 per candy. This cotton is classed as long staple African and reported to spin 60's

285-F stands second. It is reported as "far better than American middling, good for spinning 50's" and valued at Rs. 850 per candy.

Three other selections were valued at Rs. 800 per candy, seven at from Rs. 750 to 780 per candy; others from that downwards, all being valued above Scind American except two samples, one of which was equal to it and the other lower by Rs. 10 per candy.

All these American selections have much better lint than 4-F. 4-F would hardly be as good as the 126-F mentioned in Messrs. Tata's report under consideration.

The lints of the Desi cottons valued by Messrs. Tata are short and rough. Any merit that these cottons have, lies in their hardness, cropping powers, ginning percentage, etc.

285-F which has been growing on our Experimental Area for a considerable number of years now has attracted the attention of many farmers. In the year under report Nur Muhammad, Lambardar, Chak No. 232, Rakh Branch, grew one acre of 285-F in his Chak. He grew 4-F around it. In spite of a number of disadvantages 285-F gave the farmer 12 maunds kapas per acre while 4-F gave him 6 to 9 maunds per acre.

While ginning our 285-F at a Lyallpur factory we were offered Rs. 60 per maund for the lint while good 4-F there on that date was selling at Rs. 48 per maund. 285-F and 4-F have about the same ginning percentage: therefore, assuming that the seeds of both types were worth Rs. 6 per maund, the value of Nur Muhammad's crop of 285-F was Rs. 282 per acre while that of even the best plot of 4-F beside it was worth only Rs. 176 per acre—a difference of clear profit in favour of 285-F of Rs. 106 per acre.

Nur Muhammad states that he has had a large number of requests for seeds of this variety from people who saw his crop growing, and that he has sold his surplus seeds, not at Rs. 6, but at Rs. 9 per maund.

In the several years in which we have grown this variety it has kept up its reputation for high cropping and lint qualities.

The British Cotton Growing Association evidently consider its lint very much better than middling American.

As pointed out in my concluding remarks on cotton in Part II of this report there is grave need of alteration of the organization of the department in order to allow the work on improvement of cottons and other crops to proceed satisfactorily.

Wheats.—Eighteen acres of wheats were grown, and included over 250 different sowings.

Thirty-six types of Punjab wheats discovered during wheat surveys were grown in long narrow $\frac{1}{2}$ acre plots interstriped at intervals with similar plots of a standard variety. Excepting types Nos. 4 A, 8 C, 16 A, 19 J and 19 K which have been grown for four years only, they have all been similarly grown for the past seven years in plots $\frac{1}{2}$ to $\frac{1}{4}$ acre area according to the land available. The comparative results as regards yield, standing power and rust resistance are as shown in Part II of this report. The results got emphasize my opinion that so many factors affect the tests that progress can only be made in the most carefully laid out experiments if the work is in hands of specially trained men. Even then it is difficult enough to gauge accurately the influence of the numerous factors which may be affecting the cases. Without this we are exposed to the danger of collecting most misleading data which hinders progress.

Types 4 A, 16 A and 19 K stand first, second and third as regards yield. For other particulars see Part II of this report.

8-A comes fourth regarding yield. It is in the first group as regards rust resistance and at the top of the second division regarding standing powers. Its straw is as strong as that of Punjab 11, but being a heavier cropper it is slightly more inclined to bend over just at the ripening time. This wheat has been in our hands since 1910 and in the Botanical Section tests has annually beaten the best wheats at present available to zamindars. This year its outturn is 32 maunds 36 seers per acre on a $\frac{1}{4}$ -acre plot while similar plots of Punjab 11 on either side of it gave 30 maunds 32 seers and 30 maunds 28 seers, respectively.

It was handed over to the Professor of Agriculture for trial on the Lyallpur Farm in 1914 and appears the heaviest cropper where the test plots have been most comparable. For example, on square No. 26 which is under direct cultivation of the Farm it has been grown since 1915 and has annually beaten Punjab 11. 8-A was handed over to the Deputy Director, Hansi, in 1915, and in the past three years has topped the list there. It was handed over to the Deputy Director, Gurdaspur, in 1915, and it appears to be the best yielder there. It has been grown also on the Sargodha Farm for two years, and again where the tests were most comparable it has done best.

Where 8-A has been grown outside the Botanical Section and this result has not been got, inspection or enquiries usually show us room for the discrepancy. At every turn, however, experience reiterates the vital need for all testing work to be done under men especially trained for it and for an organisation such that any misinterpretation of results should recur to the loss of the person in charge.

Farmers like 8-A because among other things it is bearded and has moderately hard amber grains which do not shed easily when ripe; tillers and crops well on ordinary zamindari lands, etc. They find that it is less easily weeviled in the store than Pusa 12 and they prefer it to Punjab 11 for eating purposes. In preliminary milling tests the several expert millers concerned preferred it to Punjab 11 or Pusa 12.

Analysis also showed it contained more Nitrogen than either of the abovementioned wheats.

8-A is now being sought after by farmers and is spreading rapidly in some places without Government help. I take this as some evidence that the case is sound, for I have never found farmers anxious to get a bad type.

Regarding the 25 originally classified types, later found types, and crosses see Part II of this report.

Other work.—Reference to work on barleys, grams, potatoes, dates, earcockle disease, etc., is made in Part II of this report. I regret the space allotted to me does not permit of their mention here.

D. MILNE,

Economic Botanist to Government, Punjab, Lyallpur.

APPENDIX IV.

**Annual Report of the Agricultural Engineer to Government, Punjab,
Lyallpur, for the year 1918-19.**

Introductory.—For the first two and a-half months of the year under report I was obliged on medical grounds to take leave with the result that routine work only was carried on during that period. The number of enquiries for lift irrigation plants remains low, chiefly on account of the high prices prevailing for plant and materials. Towards the end of the year a slight drop in prices took place and this resulted in a few enquiries, but landowners are still holding back in anticipation of a fall in market rates. The work actually carried out during the year is on the whole satisfactory considering that the staff and plant have been seriously depleted on account of a call made by the Army Department to exploit water in Persia.

Well-boring.—The work done under this heading refers to the augmentation of ordinary wells by boring. Two methods are employed for this purpose, one being to pierce the impervious stratum and tap the water-bearing strata lying below, thus adding a considerable water-way area to that of the existing well. The other method, which was introduced two years ago and has proved successful for augmenting the water supply in those wells situated in districts where no impervious stratum in the subsoil is found at a reasonable depth, consists of introducing a strainer tube into a bore made to a considerable depth below the floor of the existing well. This method generally results in trebling the supply of water to the well; and the tendency is for landowners to look on this system somewhat in the light of the widow's cruse, such forcing resulting in a diminished supply. To overcome this and to meet the demand for an even greater supply, experiments with slightly larger tubes are now being started.

For this well augmentation work a staff of three well supervisors, twenty borers and twenty mates is maintained. At the commencement of the year under report two borers and two mates together with the necessary boring equipment were sent to Persia and the work has been continued throughout the year with the reduced staff and plant; the staff being further reduced and work handicapped by the influenza epidemic, stoppage of goods traffic and continued difficulty in obtaining materials combined with high prices for same. In spite of these difficulties the work of this section shows an improvement over the previous year. The number of bores sunk being 349 as against 337 in the previous year. Successful borings numbered 271 showing a percentage of 77.6 against 74.4 in the previous year.

The number of wells treated with convoluted strainers amounts to 158, all of which were successful—the water supply obtained from these amounting to 16 cusecs.

Tube-wells.—In July 1918, two of the three Mechanics employed in sinking large borings for the extraction of water from the subsoil by mechanical power were despatched to Persia along with three sets of heavy boring plant, to work under the Army Department, the third Mechanic who was undergoing boring training being recalled to cultivation work on the Bara Reclamation work. Without staff and plant it was therefore impossible to take up any of this class of work during the year. The tube-well installation at Chak Hiraj in the Ferozepore District which was mentioned in the previous report as "in progress" has been completed and yields one and a-half cusecs; the alterations to the installation at Jalalabad in the Mamdot Estate referred to in the previous Annual Report have again been taken in hand by a Mechanic under training and work is slowly proceeding. There is difficulty in obtaining the class of mechanic suited to this class of work and when obtained training takes some considerable time; this combined with the fact that boring plant to replace that sent to Persia has not yet been obtained augurs badly for the ensuing year.

Implements.—Attention has been devoted to the design of a suitable clip for attaching tines or working points to hoes, cultivators, harrows, etc. The object being to eliminate bolts and nuts so that the worker could quickly alter the position of such points to suit soil conditions. Tines when fastened by bolts and nuts (the ordinary method of attachment) are seldom or ever altered on account of the waste of time involved and the necessity of having a special tool for the purpose, which is seldom to be found in the field when the alteration is required.

The clip designed has been under trial for several months and has proved satisfactory. Mr. Faulkner devoted a large amount of his time to the consideration of many designs from the cultivators' point of view and without his co-operation a suitable form of clip could not have been evolved.

Disadvantages in the Egyptian form of disc-thresher having been pointed out, a conical convolute special type has been designed and a sample made up. This implement on tests superintended by Mr. Roberts and Malik Sultan Ali shows an improvement over the Egyptian type and further improvement is anticipated on models now under construction.

Wheels and axles for country carts have been designed and several samples made up; it is presumed that these will shortly be judged by duly qualified experts. The points aimed at in construction being a smoother running, longer wearing wheel, of equal strength and

similar cost to the type in general use. A simple and satisfactory form of all round seed drill has not yet been evolved, although considerable time has been spent in designing and experimenting with different types.

Other works.—A small sugar boiling plant has been designed and erected at Gurdaspur at a cost of Rs. 6,000 and will be put in operation next cold weather.

Owing to the high price of sheet iron, experiments have been carried out with a light form of reinforced concrete slab for roofing and partition work, the type produced proving a satisfactory and economical substitute.

Investigations carried out during the past few years into the flow of water through sand of the various types found in the Punjab enable one to forecast with considerable accuracy the ultimate depression head necessary to obtain a given supply of water from a well or tube-well and also indicate the steps necessary to prevent undue rise of subsoil water level in those irrigated tracts where water-logging is imminent. The investigations indicate the necessity for legislation with regard to the quantity of water to be withdrawn from the subsoils. The result of this work will shortly be published.

Detailed drawings prepared throughout the year number fifty-six, of these over thirty involved novel design.

The high market rate for metals, etc., has caused a further delay in obtaining the Agricultural workshop, as the estimate approved a few years ago is now very considerably enhanced. It is hoped that Government will recognise the necessity of this workshop and sanction the funds required for its construction. Without plant and labour capable of making up machines expeditiously one's ideas become stale and possible solutions to many interesting problems are lost on this account.

T. A. MILLER BROWNLIE,
Agricultural Engineer to Government, Punjab, Lyallpur.

Appendix A:

WELL-BORING.

Serial No.	Name of district.				WELLS.		REMARKS.
					Number of bores.	Successful.	
1	Jullundur	...	...	...	8	8	Jullundur Circle. Percentage of success is 81.5
2	Hoshiarpur	...	...	...	31	18	
3	Gurdaspur	...	...	...	8	7	
4	Gujranwala	...	...	...	23	21	
5	Sialkot	...	...	...	29	26	
6	Amritsar	...	...	...	4	4	
	Total				103	84	
7	Multan	...	...	...	30	23	Ludhiana Circle. Percentage of success is 70.6
8	Ferozepore	...	...	...	37	23	
9	Lahore	...	...	...	63	42	
10	Ludhiana	...	...	...	37	30	
	Total				167	118	
11	Gurgaon	...	...	...	34	30	Rewari Circle. Percentage of success is 87.8.
12	Karnal	...	...	...	28	27	
13	Ambala	...	...	...	17	12	
	Total				79	69	
	GRAND TOTAL				849	271	or 77.6 per cent.

Appendix B.

DETAILS OF STRAINERS USED IN WELLS OF THE PUNJAB.

Prior to July 1918.

Circle.	District.	Number of strainers.	Average yield of well before strainer was used. Gallons per hour.	Yield after strainer was used in gallons, per hour.	Average cost per well
					Rs.
Jullundur	Hoshiarpur	71	640	2,200	145
	Amritsar	41	780	2,600	170
	Gurdaspur	8	575	2,400	130
	Jullundur	1	930	3,000	180
	Gujranwala	2	615	2,200	136
	Sialkot	13	480	2,000	132
LUDHIANA	Montgomery	12	630	2,800	150
	Lahore	35	680	2,200	135
	Multan	25	420	2,100	140
	Ferozepore	7	570	2,900	120
	Ludhiana	11	550	2,800	130
REWARI	Gurgaon	3	600	2,300	150
	Karnal	4	500	2,800	150
	Ambala	3	360	2,600	130

Year under report ending June 1919.

JULLUNDUR	Hoshiarpur	12	620	2,200	114
	Amritsar	4	550	3,100	200
	Gurdaspur	5	1,500	3,800	190
	Gujranwala	21	500	2,500	140
	Sialkot	26	1,000	4,000	120
LUDHIAN	Lahore	21	560	2,300	140
	Multan	16	770	2,700	140
	Ferozepore	14	1,000	2,400	110
	Ludhiana	10	500	2,800	160
REWARI	Karnal	20	680	2,700	110
	Ambala	5	440	2,200	130

NOTE.—The average cost given excludes all labour.

APPENDIX V.

Report of the Deputy Director of Agriculture, Lyallpur, on District Work for the year ending 30th June 1919.

The main results of the year are as follows :—

- (1) *Confirmation of the value of line sowing and interculture for cotton.*—It is estimated that 12,000 acres in the Lower Bari Doab Canal and 6,000 acres on the Lower Chenab Canal were sown in this manner this spring.
- (2) *Confirmation of position of 4-F. as against No. 280 and No. 285.*—Latter is being tried again.
- (3) *Mollisoni* retains lead in Desi cottons, followed closely by Roseum.
- (4) This year No. 11 wheat has done better than 8-A which for previous 3 years had given slightly better results.
- (5) *Possibility of using less water on cotton in May, June and early July again demonstrated.*—This is very important in connection with building of future canals and possibility of sparing water from linked canals for early sowings in Inundation Canals. The correct number of waterings in a dry year appears to be two.
- (6) Beneficial effect of harrowing with the Bar-Harrow in wheat and cotton has been demonstrated and is gaining in popularity in the district.
- (7) *Effect of ridging cotton in saving water, especially in September and October indicated.*—I have again to draw attention to the paucity of staff of a permanent character given. Very little work has been possible in Jhang and Gujranwala and none in the three south-western districts where much could be done if staff were available. Even the training of Assistants for new circles when formed is not satisfactory. In Lyallpur only one Agricultural Assistant was available for District work with the Extra Assistant Director of Agriculture. I note below on the various heads under District work :—

Reapers.—The high price of Rs. 440 per reaper completely checked sales. A number of Reapers were inspected and repaired by Volkart Brothers. Until prices come down little demand is to be expected.

Country implements.—The Bar-Harrow continues popular and sells steadily throughout the year. The total sold is 293 including 55 in June. There are over 70 orders in hand. The average area harrowed per implement comes to 96 acres which is extremely high. These implements as made in the villages have not been satisfactory owing to the quality of the steel pegs being poor. This harrow costs roughly at present prices Rs. 6 for wood, Rs. 6 for steel and Rs. 3 for labour, etc., or a total of Rs. 15. It is sold at Rs. 10, as compared to Rs. 8 last year in pursuance of the policy of Government to facilitate increase of food stuffs as recommended by the Food Stuffs and Transport Board formed during the War. After another year unless price of material decreases considerably the price will be raised. As much as Rs. 1-8-0 per day has been offered for the hire of these implements in the villages.

Drills and Hoes.—Forty-two Kharif and 58 Rabi drills were sold during the year. These are making slow but steady progress. The Lyallpur Hoe, though not pushed by the Department, is finding favour, and 86 were sold during the year. Drills and Hoes are not sold at a reduced price—the latter costs Rs. 11 and the former Rs. 14 each. All these implements are made at the Farm and proposals are being submitted for securing permanent mistries for this work.

The cultivator made in the College Workshop and referred to last year is doing good work; it is not yet made on a large scale, but efforts are being made to get a firm to take it up. We have sold during the year 25 Planet Junior Hoes at Rs. 66-8-0, and we have orders for 30 more in hand. As this implement is similar to the cultivator evolved by Mr. Brownlie and Mr. Faulkner the room for expansion in this direction is obvious.

Cotton and Maize in Lines.—Very heavy demands were made for assistance in demonstrating sowing and interculture and over 200 persons received direct or indirect instruction at Lyallpur. The total area in lines in my Circle this year is estimated at 18,000 acres for cotton. A fair amount of maize has been sown in lines and intercultured also. The advantages of line-sowing and interculture have been appreciated more rapidly in the Lower Bari Doab Canal especially in big holdings than at Lyallpur. The number of men doing this at Lyallpur is of course far greater as we are dealing in the Lower Chenab Canal with smaller holdings as a rule.

Cotton work.—The area under American cotton was estimated at 370,000 acres and is this year reckoned to have reached 4 lakhs of acres at least. The crop did well and excellent prices were received varying from Rs. 18 to Rs. 24 per maund for kapas. Practically all the American cotton grown consists of 4-F. type now. About 2,000 maunds of seed were sold on the Sirhind Canal this year mainly through the efforts of Mr. Jesson, Executive Engineer.

Cotton Seed Farms.—Details of working of seed farms were given in last year's report. We sold 20,000 maunds of seed in Lyallpur and Montgomery. More seed would have been sold but for the disturbances which occurred in April when purchases are made by the zamindar.

Cotton auctions.—Three of these, *viz.*, two at Lyallpur and one at Toba Tek Singh were conducted by the Co-operative Credit Department with technical assistance in classification, etc., from the Agricultural Department. These auctions were very successful and 40,000 maunds were sold. The Department conducted all the auctions at Montgomery (five in all) and four at Lyallpur. Two auctions, *viz.*, at Tandlianwala and Sangla had to be abandoned on account of lack of outside competition, the buyers being able to buy cheaper elsewhere. Now that buyers are established in Lyallpur, auctions will be difficult to run successfully unless all growers support them. As in recent years in spite of successful auctions we have only disposed of 6 or 7 per cent. of the crop, it has always been possible for established buyers to get plenty of cottons outside the auctions, at cheaper rates. Our best customers at these auctions have generally been new buyers, *e. g.*, Bombay, Ahmedabad Mill Agents, Tatas and sometimes the Japanese Companies or speculative Factory owners. In the Montgomery Circle, auctions may be expected to find favour for some years to come. For the whole tract, however, the ultimate solution is co-operative sale in some form.

Some of the larger growers in Montgomery combined to lease a factory and gin and press their own cotton this year—this was a new departure of some significance, and it is to be hoped will be persisted in. Such a combination, however, unless it is very strong and can sell throughout the season, runs some risks in years of fluctuating prices.

Wheat Seed Farms.—No. 11 continued to do well—reports from all over the circle confirm the good opinion formerly held of it. Seed of 8-A wheat was given out to four growers for trials—from previous three years' results it was thought it might do better than No. 11. No real test was made, but growers made general observations and two definitely say it is not as good as No. 11—the other two merely remark that it is a good wheat. As pointed out in another part of the report No. 11 did better on the Farm and with tenants. Experience with 8-A shows what caution is necessary before widely pushing any so-called improvements. It is still possible 8-A may be put out if on an average of a number of years it proves to be better than No. 11.

The area under No. 11 is estimated to be 2½ lakhs of acres this year and it is spreading rapidly in Gujranwala and in the Lower Bari Doab Canal tract where wheats were very mixed two years ago. A note on the methods of spreading No. 11 appears in last year's report. The high prices this year seriously affected sales of seed of which over 20,000 maunds were disposed of during the year. The Section made a profit of Rs. 45,000 on wheat seed work alone in spite of supplying Co-operative Credit Societies at reduced rates.

Some "ear-cockle" and "bunt" disease was noticed this year in the Colonies. Very little had been observed here previously.

Narwala Reh Farm.—This was given up by the Chemical Section in 1916 and a Mukaddam left in charge. As latter could do very little the Agricultural Section arranged to inspect the place and keep a note of condition from 1918 onwards. A Reh map is being prepared annually to show increases of kallar patches if any. After wet season of 1917 very few patches appeared; last year, however, after a dry year a number of kallar spots showed. The total area affected is 19 kanals 9 marlas. Yields are recorded based on estimates and weighing in case of selected plots. The average is as follows for wheat :—

1916-17	...	...	...	18 maunds 18 seers.
1917-18	...	...	...	18 maunds 13 seers.
1918-19	...	...	...	16 maunds 4 seers.

Cotton gave 5 maunds 39 seers in 1917 and 6 maunds 15 seers in 1918. The cultivators are Janglis and very unprogressive, so some deterioration may be expected during the next few years.

Work with Co-operative Department.—In addition to cotton sale work we are advising on Demonstration plots run by the Co-operative Credit Department at Montgomery. Training has also been given to 10 Sub-Inspectors who attended the Vernacular Class and to parties who visited Lyallpur at the request of the Registrar.

Propaganda work.—A new practical class of one fortnight's duration for Zamindars is being started at Lyallpur Farm—it will for the present be done twice a year only. For the class opening in August, over 50 names have already been received. Training in handling implements and line sowing will be the main features of these classes.

I have been assisted throughout the year by Mr. Faulkner: Chaudhri Muhammad Abdulla, Bh. Charan Singh and Bh. Labh Singh have done excellent work. Bh. Labh Singh is now working as Farm Manager, but was in charge at Montgomery up to January. The Section suffered by the loss of Bh. Inder Singh, Farm Manager, who died of influenza in November last—he was one of the most promising old students of the College and a very real loss to the Department.

Assistance in District work and with Agricultural Associations has been received, especially from Mr. Henriques, Deputy Commissioner, Montgomery, Mr. Beazley, Colonization Officer, Mr. Cannell, Superintending Engineer, Mr. deMontmorency, Deputy Commissioner, Lyallpur, and others.

W. ROBERTS,

Deputy Director of Agriculture, Punjab, Lyallpur.

APPENDIX VI.

**Report by Maulvi Fateh-ud-din, Deputy Director of Agriculture, Gurdaspur,
ON DISTRICT WORK.**

I WAS 6 weeks on leave and spent 206 days on tour during the year under report.

The lines of demonstration and district work are not very different from those of the last year and come under the following heads:—

- I Demonstration of improved agricultural machinery and methods of cultivation recommended by the Department.
- II Supervision and starting of private seed farms and the propagation and supply of improved and pure seeds.
- III Demonstration farms.
- IV Demonstration plots.
- V Sale of implements.
- VI Agricultural Associations.
- VII General improvements in Agriculture and advising zamindars how to improve their lands and cultivation.
- VIII Auction sales of American cotton.
- IX Destruction of cotton bollworm by breeding parasites and distribution of parasite boxes.
- X Destruction of cane-borer by removal of "Dead Hearts."
- XI Experiments on potato storage against potato moth and potato rot.
- XII Chilianwala and Kala Shahkaku farms.
- XIII General agricultural improvements, etc.

Demonstration of implements and of methods of cultivation.

1. The use of furrow turning ploughs, especially in weedy lands, hot weather ploughing and deep cultivation for cane.
2. Sowing of cotton and maize in lines and their interculture by hoes and ploughs.
3. The use of spring tined cultivators for ordinary cultivation and conservation of moisture.
4. Harrowing of young crops.
5. Green manuring.
6. The sowing of improved varieties of seeds.
7. The use of foddereutters to economise fodder.

The demonstration of agricultural machinery is carried through our staff in districts where we have Agricultural Assistants. The system of an itinerary beldar who carries with him in cart a number of implements recommended by the Department, which was started three years back, has been very successful. He goes from village to village ploughing and preparing a piece of zamindar's land for him, thereby showing him and his neighbours how much better work can be done by these implements. The advantage of this system is that while few people are so interested as to go to our demonstration and experimental farms, every one in the village has an opportunity of seeing the working of these implements and watching the results obtained from their use.

Demonstration of improved agricultural machinery is also given at cattle and other important fairs; and during the year under report such demonstrations were given at the following fairs:—

Name of fair.				Place.	District.
Dussehra cattle fair	...	...	...	Jullundur City	Jullundur.
Horse Show	...	...	...	Sargodha	Shahpur.
Cattle fair	...	...	...	Mianwali	Mianwali.
Gulu Shah	...	...	...	Kereki	Sialkot.
Cattle fair	...	...	...	Throh	Sialkot.
Cattle fair	...	...	...	Sialkot	Sialkot.
Cattle fair	...	...	...	Narowal	Sialkot.
Horse show	...	...	...	Gujrat	Gujrat.
Besakhi fair	...	...	...	Anandpur	Hoshiarpur.

Besides these, demonstrations of implements are also given at Gurdaspur Agricultural Station and Sargodha Seed Farm and at the demonstration farms at Beas, Sialkot and Gujrat, when a number of zamindars visit the farms. These are also arranged in different villages where people are interested in these things in districts where Agricultural Assistants are stationed.

Some of the district boards are beginning to take a lively interest in these demonstrations at their cattle fairs and offer prizes for ploughing competitions and agricultural exhibits to encourage the use of these implements and good and pure seeds. The district boards of Jullundur and Shahpur have been very liberal in their awards and deserve our special thanks. Others which follow their example on a smaller scale are Sialkot, Gujrat and Mianwali. Most of the prizes for these competitions are given in the shape of improved implements. This commendable example of these boards should be brought to the notice of others too. At Jullundur and Sargodha there was a very keen competition both in ploughing and agricultural exhibits. Jullundur people exhibited some of the best produce that labour and attention can bring forth. Such were put in the refreshment tent on the prize giving day and evoked a good deal of interest among the spectators. Most of the district board funds come from the pockets of zamindars, and the money is well spent if it can help them to grow better crops and to get more from their lands. These prizes though of no great value yet produce a keen desire in the competitors to grow and select good seed and thus help in their future propagation.

The lending of implements to interested zamindars and members of our associations is going on as usual, and there are now over 500 implements of sorts on loan.

The practical results of these various forms of demonstrations inspite of the high prices of improved implements and the difficulty in getting them are very encouraging. During the year under report the following number of different implements has been sold out, in this circle :—

Punjab and Raja ploughs	...	...	...	81
Meston ploughs	...	...	...	200
Bar harrows	...	...	...	40
Other harrows	...	...	...	8
Reaper	...	...	...	1
Fodder cutters	...	...	...	6
Hoes	...	...	...	8
Other implements	...	...	...	6
Total				350
				and
we have now in this circle—				
Ploughs	...	...	...	2,877
Harrows	...	...	...	174
Other implements	...	...	...	193
Total				3,244 implements

in use by zamindars.

The demonstration of sowing of maize and cotton in lines has been very successful, and some 90,000 acres of cotton alone have been sown under our directions. This does not include the area which has been sown similarly by zamindars themselves—its usefulness having been demonstrated in the previous years, but we have not been able to visit them so far—and nothing could be more gratifying than to find a whole village following this practice where there was only a few acres sown in lines or only one cultivator following this method last year.

People are now getting to realize the benefits of harrowing and hoeing of crops and the practice is now spreading.

Seed farms and the propagation and distribution of improved seeds.

Wheat in the central districts and wheat and cotton in the Lower and Upper Jhelum Colonies are the two main crops with us and the distribution of their pure seeds is taken up on a large scale. For want of anything better the seed of Pusa 12 in the central districts, and of Punjab 11 and 4-F Cotton in the two colonies are produced and distributed under the supervision of the Department. There is also a great demand for the Gurdaspur farm cane seed in that district. The other seeds which are also supplied are the Australian bajra, Japan sarson, safflower, maize and groundnuts.

It is very satisfactory to report that our seeds are in great demand and this demand is increasing every year. During the year under report 1,640,000 lbs. of wheat and nearly 311,600 lbs. of 4-F cotton were sold out for seed under the supervision of the Department. Besides, large quantities of seeds of our wheats and cottons are selected and kept by the cultivators for their own use.

Demonstration farms.—There were three of these farms at—

1. Beas.
2. Badiana.
3. Gujrat.

These farms are very useful institutions and serve not only to introduce the Department and its various activities, *viz.*, introduction of improved implements and seeds and better methods of cultivation in their neighbourhood but serve as centres of our district work and form the nucleus of seed distribution. The methods found successful thereon are easily taken up as these farms are run, under zamindari conditions. I hope the commendable example of these boards will be followed by others too as soon as the Department can send out an Agricultural Assistant to each district. Money spent upon the improvement of agriculture is not wasted as long as it means better cultivation, better outturns and more profits and consequently a prosperous community and a prosperous district and district board.

Of the three farms mentioned above the Badiana farm has been given up as it was out of the way. Since the opening of the Sialkot-Narowal Railway line, Badiana, which was a great centre for passenger traffic, is no longer a frequented place. A site at Sialkot has been acquired and the new farm is being laid out. The expenditure on this farm during the period under report was Rs. 907-4-5 and the income Rs. 1,341-2 0.

Of the other two, Beas continues to prosper with an income of Rs. 1,993 2-9 and an expenditure of Rs. 1,766-10-6 but at Gujrat things are not so very bright. There are very great labour troubles. The board is not prepared to pay more than Rs. 9 or 10 per mensem for holders, and in these days of dear labour and high prices no labourer sticks to the hard work on the farm on that pay. The result is that the farm work is carried on in a very unsatisfactory manner. The soil of this farm is moreover badly lacking in organic matter and with the paucity of labour all improvements on the farm are slow. It is, however, looking much better than when we took it over.

The Jullundur District Board has acquired some 50 acres to start a demonstration farm of their own, while arrangements are in progress for the acquisition of lands for similar farms at Hoshiarpur and near the Khalsa College, Amritsar. The district board, Ludhiana, are also acquiring and reserving land for a similar farm till the Department can help them with an Assistant to run it. All these new farms are being paid for and equipped from Director's wheat profits grant.

Demonstration plots.—This is a new line of work. A plot of land varying from one to five acres of average soil is selected in a village with some interested cultivator who promises to carry out our instructions *in toto*. He provides everything, cattle, labour and our seeds, for which he pays. The Department helps him with advice and in some cases lends a plough or a harrow, and the Agricultural Assistant in charge of the district or a Mukaddam supervises and helps in carrying out different operations recommended,

The results obtained so far from these demonstration plots have been encouraging and there is a keen demand for such plots in almost every village where we are known, but for lack of trained staff we are unable to handle more than nearly 5 dozens which have been started in the Gurdaspur, Jullundur and Hoshiarpur Districts,

Mr. Darling, in his last annual report commenting upon these plots, has mentioned that these plots have produced from 35 to 55 per cent. better crops than their neighbours under zamindars' own cultivation. The results of these demonstration plots during the period under report were :—

Name of place.	District.	OUTTURN PER ACRE IN MAUNDS.		Crop.
		Demonstration plot.	Cultivator's Plot.	
Chuheki	Jullundur	9	6	Cotton.
Chima	"	44	34½	Maize.
Nakodar	"	Results reported better but not available.	...	Wheat and cotton.
Bhenimilwan	Gurdaspur	25	17	Wheat.
Lakhan	"	10	10	"
Khauna	"	8	5	"
Shahbazpur	"	12	6½	"
Baharwal	"	4½	3	"
Guptala	"	7	5	"
Salehpur	"	16	8	"
Nakodar	Jullundur	13½	Nil, could not be sown, no conserved moisture for sowing seed.	...
Shankar	"	Results reported better but not available.	...	Wheat and cotton.

The Nakodar plot, of Misar Mela Ram, of wheat was a most successful one as barani sowings could not be attempted in the neighbourhood of that place for want of moisture at sowing time. There were only three other fields of wheat in the barani area of that place within some miles of our plot, and those too were very poor.

Sale of implements.—The following firms stock the improved implements recommended by the Department:—

Messrs. Octavius Steel and Co., Lyallpur	...	Punjab and Meston ploughs.
Messrs. Volkart Brothers, Lyallpur and Sargodha	...	Raja plough, Spring Toothed Harrow, Chaffcutter, Reaper, Hand and Horse Hoes.
Messrs. Burn and Co.	...	Meston ploughs (not recommended in the presence of Ransome's Mestons).
Messrs. Macbeth Brothers of Bombay	...	Peg Toothed Harrows.

But owing to the shipping difficulties created by the war, it has not been possible for them to keep up their stocks of implements. This has been a great obstacle in the way of their rapid sale. Prices further have gone up very high and some of the expensive implements have become almost beyond the reach of ordinary cultivators. Still the demand for light Meston plough, inspite of the fact that its price has been almost trebled since the pre-war days, has always been very great, and the inability of the firm to supply these has caused a great disappointment. Messrs. Burn and Co., too, though they manufacture these light ploughs locally, have not been quite prompt to supply our indents. Their material and finish moreover are poor as compared to Ransome's ploughs and people only buy them because they cannot get the others.

Agricultural Associations.—There are five of these associations at Jullundur, Gurdaspur, Hoshiarpur, Sialkot and Sargodha. There is a proposal to start another in Gujrat. These associations are doing good work and the members are getting more and more interested in the work. There are now very lively and keen discussions on various topics of agricultural interest in their meetings.

Potato storage experiments at Sialkot.—Sialkot is a great potato growing centre and most of the supplies for the western districts, especially the big military station of Rawalpindi, are met from this place. A couple of years ago it was brought to our notice that seed tubers were being spoiled in storage by a moth—which causes very great damage, that goes as high as 70% and in some cases even more. Literature on the subject showed that the pest was known in other parts of India too, and storage in pure dry sand was said to have been effective against its ravages. It was accordingly decided to try a storage experiment at Sialkot. In the first year 8,200 lbs. of tubers were stored in sand to benefit from the experience of other places, and as we had no previous experience and were ignorant of the details of storage, we were able to save only 46% of the seed, while none of the private storers could show half as good results, for none could boast to have saved 25% even. This encouraged us to try further experiments and most of the storers also adopted our method, but unfortunately a fungus called Rhizoctonia, which caused rot, appeared and caused considerable damage. This year further experiments are being carried out in consultation with the Imperial Mycologist to fight both the moth and the rot. The experiment is of very great economic importance, for seed worth nearly a lakh is stored here every year.

Chilianwala seed farm.—Some ten rectangles were given to the Department to start a seed farm in the Upper Jhelum Colony but no funds were provided. The land was, therefore, given out on lease to get it levelled and cleared of jungle.

It has this year (1919-20) been given on Batai, only $\frac{1}{2}$ rectangle having been kept under our direct cultivation to serve as a demonstration to our tenants, who must use our implements and grow our seeds. There are no buildings so far on this farm and the tenants are greatly inconvenienced. Sanction, however, has been accorded for the construction of some temporary huts and the Public Works Department hold out promises of completing them before the advent of the winter.

Rice farm at Kala Shahkaku.—Similarly six rectangles have been made over to the Department at Kala Shahkaku for a rice farm with out any funds for starting the farm, for which we must wait till the present financial stringency is over. This land too has been given out on lease at Rs. 7-8-0 per killa for a year.

General.—Among other things castor cake for manure and sunnhemp seed for green manuring were arranged for and supplied to different places in the Province.

The demand for all sorts of seed from the farm at Gurdaspur is so great that we shall soon have to make some arrangements to meet this demand. I think we must not confine ourselves to seeds of wheat and cotton only, but there must be some one centre from where we should be able to supply seeds of all kinds of cereals and fodder crops. It is not very essential that there must be seeds of improved types only, but pure good seeds of the best of local types alone would do very well to keep the newly awakened interest in agriculture.

The services of trained Mukaddams and labourers are in great demand which is a very hopeful sign of the desire among the big proprietors to do something practical. But as really good men must be sent out, most of the applicants have to be disappointed. Arrangements are now being made to train a good number of such men, and during the period under report two Mukaddams were trained and sent out.

From the number of enquiries that are made on various topics of agricultural interest and applications for all sorts of seeds that are pouring in, it is evident that the existence and the work of the Department are appreciated and have secured the confidence of the people.

A misconception.—Some misconception prevails as to the limit and the possibilities of the recommendations of the Department. It is frequently urged that the measures recommended are beyond the reach of the cultivating community. I am afraid it is not clearly understood that all improvements in agriculture and better methods of cultivation though they will amply repay outlay involve a higher expenditure than the backward and primitive methods. Whoever wishes to adopt them must be prepared to put some money into them. Even pure and good seed—the easiest way to increase the outturn, must cost more than the sweepings from a banya's shop. The Department cannot work miracles. There must be good cattle and good implements to work the land, and sound and healthy seed to put into it. It is well to recognise that agriculture like all other business concerns requires some capital and to improve and develop the business more capital must be introduced.

Staff.—Chaudhri Gurdial Singh was transferred to Kahuta farm and his place as Farm Manager, Gurdaspur Agricultural Station, was taken by M. Mukhtar Nabi. The former was later returned and after a short trial of Chaudhri Allah Ditta, P. Chandan Ram has now been sent to Kahuta. This deprives the circle of an old hand and the work in one district must suffer till some one is available to take his place.

The staff remains undermanned, and until fully qualified men are available it is little good expanding work in other districts. I was given four certificated men last year, but one was removed to Hansi Circle, three more have been sent to this circle this year; but these fresh men need another two years on our farms to be worth anything. Unfortunately the staff given me during these two years does not hold out much promise.

I am glad however my staff, rank and file, have done their best to make the work a success. The ever-increasing office work has been cheerfully carried on by the office without much complaint. Among the Agricultural Assistants on district work Q. Samiullah deserves special mention. He has very creditably managed the heavy colony work and has made the Department's activities known to every cultivator, however sluggard and indifferent.

Dated 22nd August 1919.

FATEH-UD-DIN,
Dy. Director of Agriculture,
1st Circle, Punjab, Gurdaspur.

APPENDIX VII.

Annual Report of the Deputy Director of Agriculture, Punjab, Hansi, on District Work for the year ending 30th June 1919.

THE year under report was rather abnormal, there being very little rain except in the month of August 1918 and some showers in January 1919.

General. The season was very unfavourable for barani crops, both kharif and rabi. Late kharif sowings were done, but they altogether failed owing to the subsequent dry season. Season was equally unfavourable for barani rabi, though early sown grams and rape ripened, and the winter rains were useful for them.

There were no serious crop pests, but most of the land in barani "Ilaga" remained bare for the last year, and grass-hoppers are therefore in abundance, and complaints have been heard of their damaging the young germinating kharif crops of the present year.

As mentioned in my last year's report there was practically a cotton seed famine at the sowing time and a great amount of seed was imported from outside. The sowings were delayed in most places owing to the dry season and the shortage of water in the canal. The late sown yielded 50 per cent. per acre, or even less, of the normal. Our White Flowered Bhatla Selections did well wherever they were sown, and owing to the partial failure of cotton crop of 1918 there was great demand for good Desi cotton seed this year again, and the zamindars were very keen on our White Flowered Bhatla Selected cottons. We had only enough seed for about 500 acres and this was supplied in 4 selected places to enable us to purchase the produce of this crop for seed purposes.

Cotton.

American cotton.—As mentioned in my last report American cotton was sown at various places in the districts of Karnal, Ferozepore, Hissar and Rohtak during the last year, but the area was, however, small and in scattered places. The yields were satisfactory everywhere, and though efforts were made to get premium for the zamindars on their crop, yet it was not possible in all cases, the quantities being small and at dislocated places.

As a result of last year's encouraging experience we have this year distributed enough seed to zamindars to sow 8 to 10 thousand acres in the districts of Hissar, Rohtak and Karnal. The area in Ferozepore District under this crop during the present year is reported to be 30,000 acres. I am glad to say that most of the area has been sown in lines, and I am greatly obliged to Mr. Jesson, Executive Engineer, Sirhind Canal, Ferozepore, who has given great assistance in the introduction of American cotton in his Division. The condition of the crop is reported promising.

A very fair quantity (10,000 maunds) of wheat seed was stored last year for distribution to zamindars, but owing to the outbreak of influenza epidemic at the sowing season of wheat, the zamindars could not purchase and sow it as previously arranged.

Wheat.

However, about 4,000 acres in the districts of Hissar, Rohtak and Karnal, and between 12 and 15 thousand acres in Ferozepore were under our pure types of wheat.

Punjab 11 continues to be liked on canal-irrigated areas, though the zamindars do not care for its grain;

Pusa 12 is liked on the well-irrigated area of Ferozepore. The zamindars of Panipat who grew their entire well-irrigated area with this wheat found it difficult to control it properly at harvesting times. The size and colour of grain has also deteriorated in most cases.

8-A has done well both at the farm and with the zamindars. Owing to the very high prices of wheat seed this harvesting season, we could not make arrangements to purchase and store any very large quantity, the growers have however been advised to store their own seed. Some of the banks are also storing wheat seed?

Rice.—I arranged to get 5 varieties of rice from Central Provinces and they are being tried in Ferozepore District.

Other crops.

Sugarcane.—Five varieties of sugarcane were obtained from Gurdaspur and are being given a trial.

Red-rot has been doing tremendous damage to sugarcane crop in the Ferozepore District, and an experiment to find out the best way to check it has been started in consultation with the Economic Botanist.

Australian Bajra, Japan Sarson, Lucerne, Rhodes Grass, Groundnut and Castor plant are being grown in different parts of my circle.

Heavy prices have greatly hindered their introduction, and whenever orders were received the implements were not procurable. The following is, however, a list of implements purchased (or ordered) during the year :—

Improved Implements.

Rajah Ploughs	...	...	...	...	2
Meston Ploughs	...	...	...	...	123
Horse Hoes	...	...	...	...	1
Hand Hoes	...	...	...	...	2
Cotton Sowing Drills	...	...	...	...	19
Cotton Hoes	...	...	...	...	23
Markers	...	...	...	...	15

Demonstrations of Agricultural implements were given at about a dozen different places and the zamindars were explained the use of these implements. Some demonstrations were given to show the sowing of cotton in lines, and its hoeing by means of hoes. Over 40 Agricultural implements were lent to the zamindars for varying periods and were shifted to other places after trial. Such places were invariably visited by our Demonstrators.

The Demonstration Farm at Jalalabad has been working satisfactorily and its area has been extended. The total expenditure during the year was Rs. 4,919-6-0 and the income was Rs. 5,925-13-6, besides produce worth Rs. 1,500 still lying in the store, thus making the net profit over Rs. 2,500.

The results of Guruharsahai Farm are not so satisfactory, as a good deal of new area is being brought under cultivation and the water supply from the tube-well has been irregular.

Rohtak Demonstration Farm.—This is the first year of this farm and the Agricultural Assistant, Hissar, who was also in charge of the District work of Rohtak, Karnal, Ambala and Gurgaon districts was looking after this till the middle of December when Suroop Lall relieved him. In spite of the many initial difficulties by way of accommodation for staff, labour and cattle, the higher level of land, etc., we have sown this kharif 10 acres of cotton and the condition of crop is reported good.

I may also add that the last season's cotton crop at this farm gave a produce of about two maunds more per acre than the average of the cotton crop in the district.

Demonstration plot at Panipat.—The plot was working very satisfactorily and served very useful purpose. The owner of the plot who took great interest in Agricultural work died and we have given it up.

Demonstration plot at Bahaudin.—This demonstration plot is working most successfully, all the Agricultural implements are being used and our methods are appreciated. Last year there were about 2 acres of sugarcane and 4 acres of American cotton at this place, and as a result of success achieved, the owner has this year grown 30 acres of sugarcane (which is in excellent condition) and 140 acres of American cotton, and this has all been sown in lines.

Even the Pachada cultivator is beginning to be converted to better methods of Agriculture.

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